SCIENTIFIC AMERICAN

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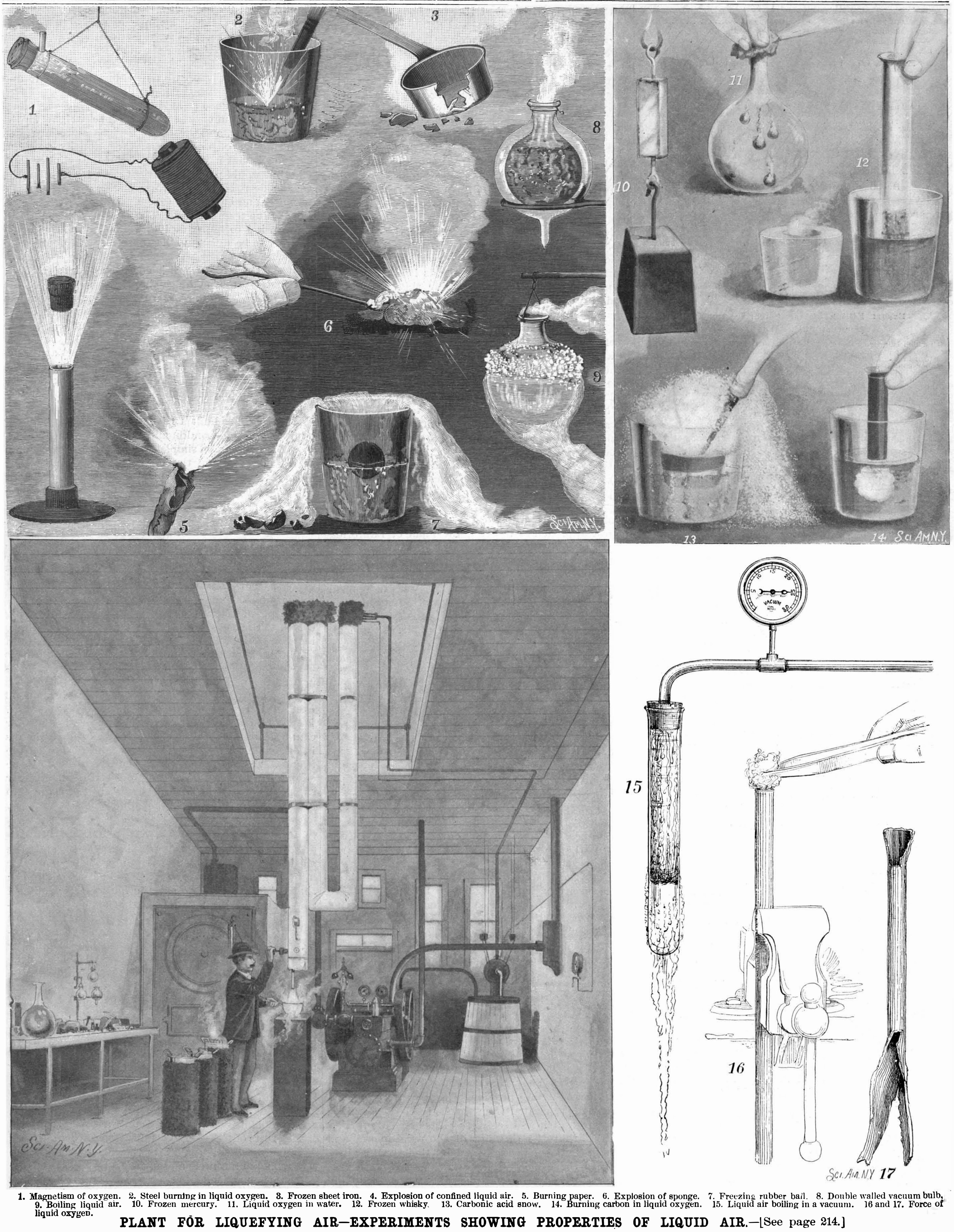

1. Magnetism of oxygen. 2. Steel burning in liquid oxygen. 3. Frozen sheet iron. 4. Explosion of confined liquid air. 5. Burning paper. 6. Explosion of sponge. 7. Freezing rubber ball. 8. Double walled vacuum bulb. 9. Boiling liquid air. 10. Frozen mercury. 11. Liquid oxygen in water. 12. Frozen whisky. 13. Carbonic acid snow. 14. Burning carbon in liquid oxygen. 15. Liquid air boiling in a vacuum. 16 and 17. Force of liquid oxygen.

PLANT FOR LIQUEFYING AIR—EXPERIMENTS SHOWING PROPERTIES OF LIQUID AIR.—[See page 214.]

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A SPANISH VIEW OF THE AMERICAN NAVY.

It is a matter of frequent remark that the average European is as densely ignorant on all questions relating to the United States as the average citizen of this country is well informed on European affairs. It is probable that outside of a comparatively narrow circle in England, France and Germany, the people of the old world have only the vaguest idea of the resources, wealth and social and industrial development of the United States. They see the nondescript crowds that migrate yearly across the western ocean, and they grow accustomed to the thought that America is a huge agglomeration of unassimilated nationalities. They little understand that such is the size and virility of the American race that these myriads are absorbed without disturbing the national equilibrium or changing a line or shadow of the national countenance.

Perhaps it is safe to say that in no European country is there so much misapprehension regarding the United States as in the very one which has good reason just now to be best informed regarding us. The information which the Spanish press is giving out to the people is such palpable misinformation that one can scarcely attribute it to mere ignorance, and we are led to believe that the misrepresentation must be willful. One of the most striking instances of this is an article on the United States navy, which appears in a recent issue of the Spanish weekly, La Ilustracion, the "Harper's Weekly" of Spain. The United States has usually been credited in Europe with possessing a navy which, though small in numbers, is of the very latest pattern and includes some of the most original and effective types of ships in the world. The Spanish journal in question, however, lends itself to the task of persuading the Spanish public that our navy is made up of poor imitations of European ships, that it is "manned by hirelings who calculate, while they are fighting, what their valor, in cents, should be worth to them;" that it is a "navy without traditions of any kind" (ye shades of Farragut, Perry and Paul Jones!) and that therefore "it will be nothing remarkable if in a short time we see all these" ill designed and worse constructed "vessels go to the rubbish heap."

The article opens by stating that ten years ago our naval efforts were confined to repairing the "Miantonomoh" and her class, which are built "partly of wood" (sic). We are informed that a navy yard has recently been started at Port Orchard, in Brambridge (sic), and that among other places where the navy keeps stores of ammunition and coal is New Oskaut (New Orleans?) on the Atlantic coast. The map of Washington fails to show the name Brambridge, the nearest approach to it being the name of Bainbridge Island, which lies about five miles distant from Port Orchard.

After our contemporary has displayed such an intimate knowledge of our geography, we are not surprised to learn that "important works for the manufacture of armor . . . have been established in Massachusetts under the direction of Mr. Bethlehem." We are informed that these "works can compete with Krupp in Germany;" but lest our confidence and Spanish dismay at this information should be too pronounced, we are informed in the next paragraph that in creating our navy "the tests of armor and other work were unsatisfactory."

This "period of feverish activity was succeeded by three years of calm," after which there came "the war with Cuba . . . and the fear of a rupture with Spain," impelled by which we "proceeded secretly (sic) to construct armored vessels," until at length we had at our disposal "what seemed to be a respectable squadron." "Fortunately for us," our contemporary proceeds, "the great funnels and quantity of smoke of the Yankees need not frighten us," and in proof of this a list of the shortcomings of the ships is added, from which we select the following:

"The 'Indiana,' 'Oregon' and 'Massachusetts' submerge the armor plate" (presumably the belt) "entirely, and can only carry a full complement of coal in time of peace." "The turrets of the 'Kerasage' (sic) and 'Kentucky' present some advantages; . . . but their axes are so badly arranged that the guns which they carry would be out of combat as soon as they began to operate." "The 'Texas' has very deficient armor;" . . . "it cannot carry the torpedoes intended for it," and the critic does not spare even the ill-fated "Maine," but informs us that "its best speed was 16 miles" (it was 17½ knots), and that at this speed "it shipped water at the bow."

The "Katahdin" "cannot go into battle on the high seas," and "its crew cannot sleep on board for lack of space." The "Miantomoh" (sic), "Monadnock" and "Terror" "are provided with a central compartment, easily separated from the body of the monitor; . . . an eccentric and senseless idea." We are further informed that the stability of the "Baltimore" and "Philadelphia" is endangered by their heavy guns, and that the armored deck of the "Cincinnati" and her class "is a source of danger, rather than of defense." Even the famous run of the "Columbia" across the Atlantic, at a speed of 18 knots, is discredited on the ground that the last day's run "could no longer be made under forced draught." As a matter of fact, the whole run was made under natural draught.

This remarkably lucid and accurate account of our warships concludes by assuring the Spanish public that "the rest of the vessels are not worth mentioning."

FOUR-CYLINDER LOCOMOTIVES.

The four-cylinder type of locomotive appears to be enjoying quite a run of popularity just now on the other side of the water. At least three of the leading English roads have built engines of this kind, and they appear to be giving satisfaction. The type is not unfamiliar in this country. The Strong locomotive reckoned the four-cylinder arrangement among its many striking novelties, and visitors to the World's Fair at Chicago will remember the James Toleman, an English engine with four driving wheels, the forward pair of which were driven by a pair of inside cylinders and the rear pair by two outside cylinders.

The object aimed at in the Strong engine was to reduce the amount of counterbalance weight in the driving wheels, and the James Toleman was designed with the view of producing an exceptionally powerful engine without increasing the size of the cylinders and one that would provide sufficient adhesion without the use of side rods. The Strong engine fulfilled all its promises and has shown exceptionally good results on the Perdue testing plant. The James Toleman, however, owing to faulty design, was a failure, the boiler proving to be quite unable to supply the four cylinders with steam.

Of the three new English engines above referred to, the first is a four-cylinder simple engine built for the Glasgow and South-Western Railway. All cylinders are connected to the leading pair of driving wheels; a pair of 14½ × 26 inch inside cylinders connect to two cranks set at 90 degrees, and a pair of 12½ × 24 inch outside cylinders connect to crank pins set at 180 degrees to the adjoining cranks. This disposition of the cranks and pins enables one set of valve gear to be used for each pair of cylinders on each side of the engine.

Mr. Webb has built two experimental four-cylinder engines for the London and North-Western Railway, one of them being a simple and the other a compound. In the simple engine the four cylinders are all of one size, viz., 15 inches diameter by 24 inches stroke, while the compound has two 15-inch outside and two 19½-inch inside cylinders, the common stroke being 24 inches.

The London and South-Western Railway is experimenting with an engine which has two outside cylinders driving the rear pair of drivers, while another pair between the frames is coupled to the front drivers. This, it will be seen, is a similar arrangement to that on the James Toleman.

It is possible that the English designers are being driven to the use of four cylinders in their endeavor to increase the power of their locomotives. The height of the bridges and the width of tunnels in that country is considerably less than here. The track clearance diagram for an English road limits the width of the locomotive to about 8½ feet and the height to about 13 feet, as against 10 feet and 15½ feet in this country. Hence outside cylinders of more than a certain diameter cannot be used and the diameter of the inside cylinders is, of course, restricted by the clearance between the frames. The four-cylinder locomotive opens up some escape from these restrictions, although, if the cylinder capacity be enlarged, it will always be a problem to find space for the bigger boiler which will be necessary.

BILL TO INCREASE THE PATENT OFFICE FORCE.

Notwithstanding the great interest in and the steady stream of appropriations now being made for military and naval purposes, it is to be earnestly hoped that a bill pending in both the Senate and House of Representatives for the allotment of a very modest additional sum for the needs of the Patent Office will not be lost sight of. In no other department of the government is it expected that the service shall be crippled or the expenses of properly conducting the business be limited by the additions we are now making to the army and navy for coast defense and possible foreign contingencies, and it would seem ridiculous, if the subject were not really so serious to all inventors, to bring up any such idea of false economy in opposition to the proposed measure.

The bill presented in both branches of Congress by Mr. Platt, of the Senate Committee on Patents, S. 4168, and Mr. Hicks, of the corresponding House committee, H. R. 7082, provides for the employment of an additional Patent Office force involving an expenditure of $62,880 a year, which, it is pointed out, is only a small proportion of the excess of fees over expenditures, in accounting for the moneys annually paid into the government by inventors, manufacturers and owners of patents. To illustrate the particularity with which the bill has been drawn and the caution exercised that there shall be no room for extravagance on the part of the Patent Office, it is especially stated that the whole number of addi-

tional employés shall not exceed four principal examiners, four first assistant examiners, four second assistant examiners, eight third assistant examiners, eight fourth assistant examiners, four first-class clerks, four copyists, six laborers, six assistant messengers and six messenger boys. It will be admitted, we think, that the business of the Patent Office has been looked into with great attention to detail when so modest an appropriation therefor is so specifically guarded. But we hope that, with such inspection of the business, it did not fail to impress itself upon the members of the Committees on Patents of both branches of Congress that the present quarters occupied by the entire force for the prosecution of their work and the keeping of the necessary records are altogether too cramped and overcrowded for the attainment of the best degree of efficiency. More room and better facilities, especially a well equipped laboratory, are quite as urgently called for as the additional force of examiners, clerks, etc.

The especial reason for bringing forward this bill at present is found, not in the well-known fact that the Patent Office has been overworked for years, and the issue of patents thereby greatly delayed, but in the need which has arisen, as a consequence of the act of March 3, 1897, for a more perfect revision and classification, by subjects matter, of all letters patent and printed publications which "constitute the field of search in the examination as to the novelty of invention for which applications for patents are or may be filed." It is now made especially the duty of the Patent Office to see that an invention for which application for a patent is made shall not be patented or described in any printed publication in any country before the invention made by the applicant, and, according to the report of Mr. Hicks, it is the intention by this appropriation to enable the Commissioner of Patents "to make examinations in a manner so thorough and complete as to insure the issuance of patents only for such inventions as are unquestionably new; so that the patent when issued shall be an affirmative statement, certified to under the seal of the Patent Office, that the invention covered thereby is new, and has not been described in any patent or printed publication." It will be seen, therefore, that the design is to enable the Patent Office to make competent examinations of the whole field of invention—embracing more than a million issued patents and a vast accumulation of technical publications—the effort to do which is already constituting a great drag on the work of the office, which is now from two to seven months in arrears, and it being evident that "the office is struggling with a load much too heavy for it to carry." The Commissioner expects that, with the additional appropriation, "the income of the office will be greatly increased by the more rapid and thorough disposal of the business and the increased number of applications which will be filed when it is assured that action upon them will be prompt and thorough."

THE FRUITS OF CIVIL SERVICE REFORM.

Civil service reform has now been on its trial for a period of about fifteen years, and each succeeding year has given stronger proof of its value in the practical results which have been achieved. In its recent annual report the Civil Service Commission points out that the merit system, as compared with the patronage system, is both more economical and more efficient. This is conclusively shown in a comparison of the few changes in employés under the merit system, as compared with the many removals under the patronage system. During five years preceding the classification of the New York Custom House there was an average of 275 removals per year, whereas during the past two years the removals averaged only 50 per year and the resignations 30 per year. The figures for the civil service of the whole country are even more conclusive, for 75 per cent of those holding unclassified positions were removed, while in the classified competitive service only 85 resigned. During the fifteen years of civil service reform the positions which are politically controlled have increased 37 per cent in number and 43 per cent in cost, while the number of classified positions not subject to such control has remained the same. The economy of the merit system is further illustrated by the fact that the extension of the civil service rules in May of last year, by which a large number of hitherto unclassified positions were brought under the merit system, led to the abolishing of a number of positions which were found to be quite unnecessary.

In spite of the objection which has been urged against the merit system, on the ground that it renders employes too independent and encouraged carelessness in the performance of their duties, a rule was approved by the President in July of last year which prohibits removals except for cause and upon written charges. On the general question we think that it is very doubtful if any serious trouble of this nature has ever arisen. If it has, it is immensely outweighed by the excellent results which have been secured, and it is a fact that the new rule has met with general public approval. It is argued that while the new rule in no way interferes with the proper exercise of discipline, it prevents abuses, guards against unjust removals, and insures that permanence in office shall depend upon efficiency and good behavior.

One of the strongest arguments against the political system is that the tenure of office is for only a limited number of years, and the appointments being made on strictly political considerations, the new incumbent may or may not have any qualifications for the special duties of his position. An equally serious drawback is the fact that the return of a political party to office is certain to deprive the government of the services of a greater or less number of employes who, during their service, have acquired valuable experience and efficiency. These points are dwelt upon at considerable length by the commission, who recommend that the scope of the civil service law be extended to embrace all positions to which it could be applied with advantage. It is specifically suggested that the municipal service of the District of Columbia, the staff of the Congressional Library, and the clerical force of the next census be brought under the civil service law.

Apart from the abstract principles involved in the question of removing the civil service from the field of politics, with which in the nature of things it has no proper connection, the financial aspects of the problem are of the highest importance. This is evident when we bear in mind that the total salaries paid out annually to the employes in the executive civil service amount to close upon $100,000,000. Bearing in mind the statement in the report already referred to, that since 1882, the year of the organization of the committee, the unclassified positions under political control have increased in cost 43 per cent while the classified positions have remained the same, it will be seen that civil service reform has an important bearing upon the finances of the country. Of the 178,717 employes in the executive civil service shown by a census of them taken last year, about one-half were in positions which were governed by the rules of the civil service.

THE HEAVENS IN APRIL.

BY GARRETT P. SERVISS.

The mild nights of early spring are adorned with constellations less brilliant than those of winter, but not less beautiful. Orion and Taurus appear, in the first half of the night, setting amid the lingering twilight, robbed of the dazzling brightness that characterized them when they were on the meridian in midwinter. Higher up glows Capella with a softened radiance, while the Milky Way stretches, like a vernal mist, across the sky from north to southwest. Overhead, south of the zenith, is Leo, and north of the zenith the Great Dipper. Virgo is conspicuous in the east, and Arcturus, high and splendid, counterbalances Capella on the other side of the meridian, while, as Sirius is setting in the southwest, the Sirius of the north, Vega, appears rising in the northeast.

THE PLANETS.

Mercury is an evening star, and there will be no better opportunity to see it this year than that presented about the 10th of April, when it will attain its greatest elongation east of the sun, and will not set until almost two hours after sundown. At the beginning of the month Mercury is in Pisces; at the end, when it passes between the earth and the sun, in Aries.

Venus also is an evening star, and gradually becoming more conspicuous, as it moves out of the neighborhood of the sun. It is not far west of Mercury at the opening of April, but, after the latter turns in its course and begins to move sunward on the 10th, the two planets will draw nearer together, coming into conjunction on the 18th, when Mercury will appear between three and four degrees north of Venus. From that time on Mercury will cease to be a conspicuous object in the sunset sky, leaving Venus to reign alone there. Notwithstanding Mr. Percival Lowell's much exploited observations and theories, there is, as yet, no good reason for not regarding Venus as the most earth-like of all the planets that circulate within or without the orbit of our terraqueous ball. The observations of it to be made during the present year should be of intense interest. At the beginning of the month Venus is in Pisces and at the end in Taurus, near the Pleiades.

Mars is in the morning sky, and still too near the sun for easy or satisfactory observation. It moves in the course of the month from Aquarius to the border of Pisces and Cetus.

Jupiter in Virgo, near the star Eta, is a magnificent sight for all who can appreciate the wonder and beauty of celestial phenomena. Recent telescopic study has revealed the formation of new spots among its great colored belts, and at all times it is an entrancing object for the possessor of a telescope. It rises before sunset, and, as the evening advances, moves up the eastern sky clothed with the majesty proper to the mightiest of the planets.

"What is that bright star?" asked a man who never looks at the heavens except by chance.

"The planet Jupiter."

"Why, I never saw such a star! Do they often look like that?"

"Not many of them."

Possessors of telescopes may watch interesting phenomena of Jupiter's satellites on the night of the 17th. At 8:15 o'clock, Eastern standard time, Satellite I. will disappear, eclipsed by Jupiter's shadow. At 8:21 P. M. Satellite II. will begin to transit the disk of Jupiter, and at 9:22 its shadow will follow the satellite upon the disk and will occupy two and a half hours in crossing it. On the night of the 28th an interesting observation may be made showing the effect of the position of the sun on the direction of the shadows of Jupiter's moons in relation to the line of sight between the earth and Jupiter. At 7:34 P. M. Satellite III. will pass upon the disk and begin a transit which will end at 10:15. But the shadow of the satellite will be so inclined to our line of sight that it will not appear on the disk until twenty-one minutes after the satellite itself has completed the transit.

Jupiter is very close to the celestial equator, and crosses it, moving northward on the 8th.

Saturn, whose rings are now admirably placed for observation, can be seen in the east, rising at the end of the month near 9 o'clock; but it will be much better situated for evening observation in May. It is in Ophiuchus, near Scorpio.

Uranus is near a little pair of stars, the Omegas, in Scorpio, and gradually gets closer to them in the course of the month. It rises half an hour or so ahead of Saturn. Its approach to the Omegas will be interesting to watch with a field glass or a small telescope.

Neptune, invisible to the naked eye, remains in Taurus.

THE MOON.

The moon is full on the afternoon of the 6th of April, and in last quarter on the morning of the 13th. The new moon of April occurs on the afternoon of the 20th, first quarter following on the evening of the 28th. The moon is nearest the earth on the 9th and farthest from it on the 25th.

The greatest eastern libration occurs on the evening of the 3d and the greatest western libration on the morning of the 17th.

The moon's conjunctions with the planets occur as follows:

Jupiter on the 5th, Uranus on the 9th, Saturn on the 10th, Mars on the 17th, Mercury on the 21st, Venus on the 21st, Neptune on the 24th.

There are several recognized meteoric showers in April, of which one, occurring on the 20th, may be worth observing. The meteors radiate from a point a few degrees west of the brilliant Vega, in the constellation Lyra.

FORTHCOMING TELEGRAPHIC TOURNAMENT.

During the electrical exposition which is to take place at Madison Square Garden during the month of May, the Board of Control will hold a Fast Sending and Receiving Tournament which is intended to surpass any contest of the sort that has yet taken place. As at present arranged, the events include:

A message class for receivers, transmission thirty minutes, receivers to use typewriters of their selection. Novice class, open to persons not having an official record; sending five minutes. Championship class, open to all, sending five minutes, with prizes for receivers. Ladies' class, free for all, sending five minutes. Two-forty-word class, open to those not having an official record of 240 words or better, sending five minutes. Two-thirty-five-word class, open to all who have not an official record of two-thirty-five words or better, sending five minutes. Two-thirty-word class, open to all who have not an official record of two-thirty words or better, sending five minutes. Two-twenty-five-word class, open to all who have not an official record of two-twenty-five words or better, sending five minutes.

The judges of the contest will include leading officials of the great telegraph companies and the editors of several leading electrical papers.

The best official records in contests of this kind were made in 1893, F. J. Kihm and F. L. Catlin sending 248 words without an error, and R. C. McCready sending 249 words with 14 errors in five minutes. An interesting feature will be furnished by Thomas A. Edison, who will make a phonographic record of the best transmissions, thus enabling contestants to listen at any time to the record of their own work.

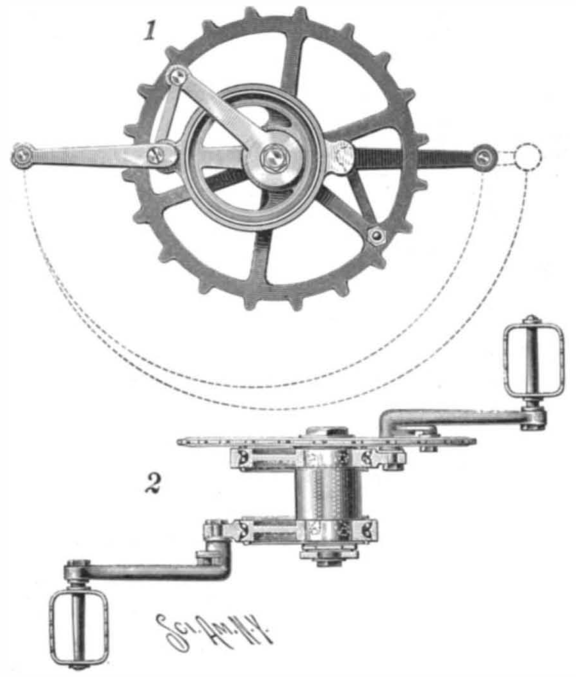
LAUNCH OF THE BATTLESHIPS "KEARSARGE" AND "KENTUCKY."

On Thursday, March 24, there were launched at the Newport News shipbuilding yard the two most powerful ships of the United States navy, the "Kearsarge" and "Kentucky." They are an improvement upon the "Indiana" class, which they exceed in size, speed and fighting strength. They are of 11,525 tons displacement and 16 knots speed, and protection is afforded by 16½ inches of steel on the belt and 15 inches on the barbettes and turrets. The main battery consists of four 13-inch and four 8-inch guns, and there will be fourteen 5-inch guns in the secondary battery. The most remarkable feature of these ships is the double-deck turrets, the 8-inch guns being mounted above the 13-inch.

For a very full description and illustration of these ships the reader is referred to the SCIENTIFIC AMERICAN of January 29, 1898.

AN IMPROVED POWER CRANK.

The illustration represents a crank designed for use in any machine driven by a crank, from a coffee mill to a locomotive, its use giving greater leverage without increasing the circle traveled by the crank pin or handle. In the engraving the improvement is represented as adapted for bicycle propulsion, Fig. 1 being a side view and Fig. 2 a view looking down from above, showing the different distances of the

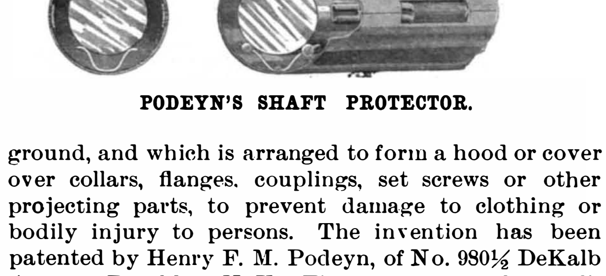


POTTS' POWER CRANK APPLIED TO A BICYCLE.

pedals from the hub of the sprocket wheel in their downward and upward movement. The improvement has been patented by Joseph C. Potts, of Berwyn, Pa., and the applicability of the principle to any machine used to transmit power will be readily seen. Forming a part of or rigidly secured to the bearings of the sprocket wheel shaft are projecting bearings for rings which carry the cranks, and which have circular peripheries that are eccentric in respect to the axis of the shaft. The opposite cranks are so secured to the rings as to constitute rigid extensions of them, and both the rings and central shaft are preferably provided with ball bearings. To each end of the shaft is secured an arm whose outer end is connected by a link to the crank, the crank being in advance of the arm, or preceding it in the direction of rotation, whereby the pull of the crank is imparted with most directness during the time the crank is passing through the operative half of its stroke. It will be observed that the gain in leverage is obtained without the use of slotted cranks, slides or other operative elements such as would cause excessive friction. As applied to a bicycle, it will be readily seen that the increased leverage, without any increase in the travel of the foot, which is a true circle, enables the use of higher gear to increase speed or results in less labor of propulsion if the gear is not increased. Where weight is carried, as in the case of delivery bicycles, this is designed to be of great advantage, and the bicycle rider will also probably appreciate any device that gives him greater speed or less exertion. In the drawing the increase in leverage and consequent power is one-seventh. By using larger eccentric rings to carry the cranks, a considerably greater increase can be obtained.

A CASING FOR SHAFTS, COUPLINGS, ETC.

The illustration represents a protector more especially designed for use on shafts at or near the floors or



PODEYN'S SHAFT PROTECTOR.

ground, and which is arranged to form a hood or cover over collars, flanges, couplings, set screws or other projecting parts, to prevent damage to clothing or bodily injury to persons. The invention has been patented by Henry F. M. Podeyn, of No. 980½ DeKalb Avenue, Brooklyn, N. Y. Fig. 1 represents the application of the improvement, Fig. 2 being a sectional perspective and Fig. 3 a cross section of the protective casing in position on the shaft, parts being broken out to show the manner of attachment. The casing is supported from the shaft and held out of contact with it by springs, preferably arranged in pairs, the middle portions of the springs being attached to the casing and the free ends of the springs resting on the shaft, these free ends having balls thereon, to reduce friction, if desired. The casing is preferably made in sections, to be fastened together when placed in position on the shaft, by riveting or screwing together overlapping parts, or, as shown in Fig. 2, the sides of the sections have internal flanges to be engaged by a key slipped through an opening in the side of the casing.

World's Gold Production in 1897.

The Director of the United States Mint, from information now in his possession, states that there is substantial evidence that the world's output of gold for the calendar year 1897 will approximate, if it does not exceed, $240,000,000 in value, an increase of close to 20 per cent over 1896. Of this total the United States produced approximately $61,500,000, an increase of $8,400,000 over 1896; Africa, $58,000,000, an increase of $13,600,000; Australasia, $51,000,000, an increase of $6,800,000; Mexico, $10,000,000, an increase of $1,700,000; Canada, $7,500,000, an increase of $4,700,000; India, $7,500,000, an increase of $1,400,000; Russia, $25,000,000, an increase of $3,500,000.

The indications for the United States, says Director Preston, are that Colorado will lead in the production of gold for 1897, as it is estimated by former Governor Grant that it will not be less than $20,000,000. California will follow with a product of probably $19,000,000. With the exception of the States of the South Appalachian range, he believes that there will be an increase in every producing State and Territory of the gold products over that of 1896.

Patent Decision on Street Car Cable Grips.

In the United States Circuit Court for the Southern District of New York, on February 19, Judge Wheeler handed down an opinion in favor of Charles I. Earll against the Metropolitan Street Railway Company, of New York City.

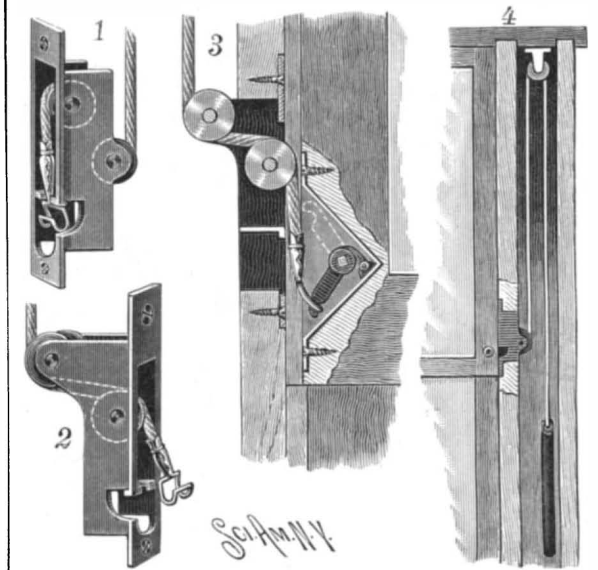
Earll was employed by the old Metropolitan Company as a draughtsman. He was assigned by the company to work on a grip mechanism for its use. He perfected the grip now in use on the cable cars of the Metropolitan Company, which was patented May 22, 1894. By the terms of his agreement with the company they were to have the right to the patent without payment of royalties or other considerations. In his complaint Earll contended that the present Metropolitan Company was not the company by which he was employed, and, therefore, had no right to the patents.

Judge Wheeler held that the present Metropolitan Company had acquired the Lexington Avenue and the Columbus Avenue lines since the time when Earll was employed by them, and that "a license to a company as such would not extend without its own limits to other roads after acquired from other corporations within their own limits or by new extensions. The defendant was not in existence at the time of the license, and its rights under the license must be such only as it has wholly acquired by succession from those who took the license in the first place."

Judge Wheeler therefore found that the defendant had the right to use the device on the original property, namely, the Broadway and Seventh Avenue road, but that it had no free license to its use on its other roads, namely, the Lexington Avenue and the Columbus Avenue roads. Under the opinion Earll can collect royalties on his patent for its use on the Lexington Avenue and Columbus Avenue lines.

AN IMPROVED SASH SUPPORTER.

In the accompanying illustration are represented improvements in sash-supporting devices designed to hide the cord and the opening through which it passes within the window casing, and also to facilitate the releasing of the cord from the sash and securing it when so released. The invention has been patented by Richard Bohrisch, of East Las Vegas, New Mexico, Figs. 1 and 2 representing slightly modified constructions of the pulley casing with the cord in place, Fig. 3 showing the manner of fastening the cord by its hook in the corner of the sash, and Fig. 4 being a sectional view indicating the operation of the device. The pulley casings are placed in the sides of the window casing, it being possible to employ a single pulley, although two pulleys are preferred, which permits the cord to be offset and carried within the vertical channel or casing within each side of the window casing, the cord being carried upward and over a pulley and attached to a weight which rises and falls in the channel. Near the bottom of the sash, at one edge, is a recess containing a casing in which is journaled a hook adapted to be turned by a crank or key inserted from the outside, the hook being adapted to engage a hook on the end of the cord. The hook in the sash casing has on its hub end a lug adapted to be engaged by a dog, to hold the hook in the desired position, as shown in Fig. 3, and a finger of the dog, whereby the dog may be released as desired, projects through a slot in the casing. To free the sash from the cord, the dog may be released, or the hook may be turned back by the key or handle to the position indicated by the dotted lines, as shown in Fig. 3. When the cord is released from the sash, it is secured in the pulley casing by placing the shank of the hook at its end between lugs and the body of the hook in a recess in the front and side plates of the casing. The invention presents some modifications in the de-



BOHRISCH'S SASH SUPPORTER.

tails of the pulley casing, though the construction is in all essential points the same.

CULTIVATING COTTON PLANTS.

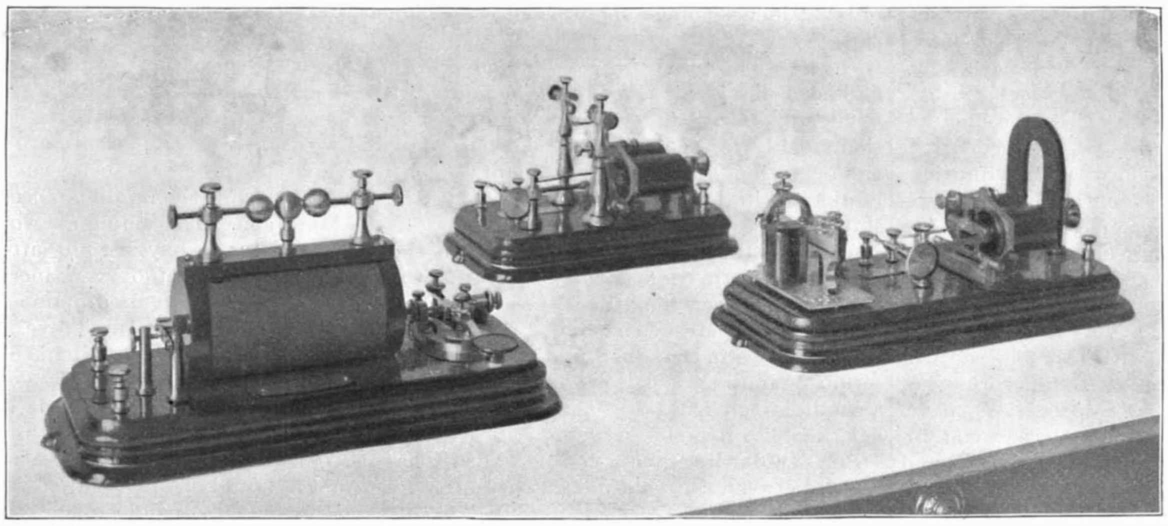
On passing an ordinary plow between young cotton plants, in the cultivation of cotton, the cotton left standing needs more or less careful and immediate attention, and to leave the plants in better shape the invention illustrated herewith provides for the attachment to the ordinary plow of an auxiliary following share or blade designed to leave the plants on a tapering or beveled ridge, while also removing grass or weeds that would interfere with chopping out surplus plants. The improvement has been patented by George D. McElwee, of Gloster, Miss. A curved supporting beam, bolted at one end to the plow beam, has a downwardly extending member with a socket adapted to receive a shank arranged for attachment to a scraper, also shown in the small figure. The scraper is curved or dished on its front face, and its upper right hand corner is curved. The shank carries a hook bolt, and the hook with the bolt are arranged for locking engagement with the front upper face of the scraper. The scraper is located at the rear of the main share of the plow, and the arrangement is such that it may readily be given vertical or side adjustment or be adjusted at any desired angle to the ground. At the upper left hand end of the scraper is an eye which receives a rod whose opposite end passes through the eye of an eyebolt in a projection or lug on the forward end of the curved supporting beam, and over this beam a bracket rack is attached to the plow handle, preventing the beam from working upward and admitting of considerable range of lateral adjustment. In operation the scraper makes

McELWEE'S COTTON SCRAPER.

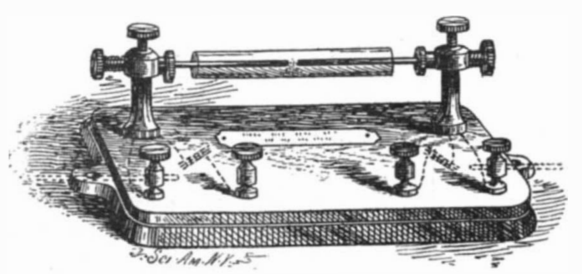
a furrow at an angle to that made by the plowshare, and the inclination of the scraper is such as to throw the dirt away from the roots of the plants being cultivated, while, should the scraper strike a stone or engage a root or other obstruction, it will yield slightly to avoid breakage, the parts being readily restored to their original position.

WIRELESS TELEGRAPHY.

At the present moment, when such strained relations exist between Spain and this country, nothing could be more welcome than the announcement of a practical method of carrying on electrical communication between distant points on land, and between ships at sea, without any prearranged connection of any kind between the two points. Many years ago it was found possible to transmit signals through space at a very short range by means of electrical vibrations, but not until the spring of last year had anything of much practical value been accomplished in this direction, with the exception, perhaps, of the method of telegraphing from moving trains which was patented in this country in 1881, and used for a limited period on short sections of two of our eastern railroads. During last year Guglielmo Marconi, an Italian student, devoted considerable time to the development of a system of wireless telegraphy, and although he has made use of well known principles, he has so arranged and designed his instruments that he has found it possible to transmit intelligible Morse signals to a distance of over ten miles. It has been left, however, for the American inventor to design apparatus suitable to the requirements of wireless telegraphy in this country. After months of experimenting Mr. W. J. Clarke, of the United States Electrical Supply Company, of this city, has designed, and his company is placing upon the market, such a complete set of wireless telegraphy apparatus that it will in all probability come rapidly into use. For the information of our readers, we illustrate the various pieces of apparatus used, and also explain, with the aid of diagrams, its internal construction and method of operation.

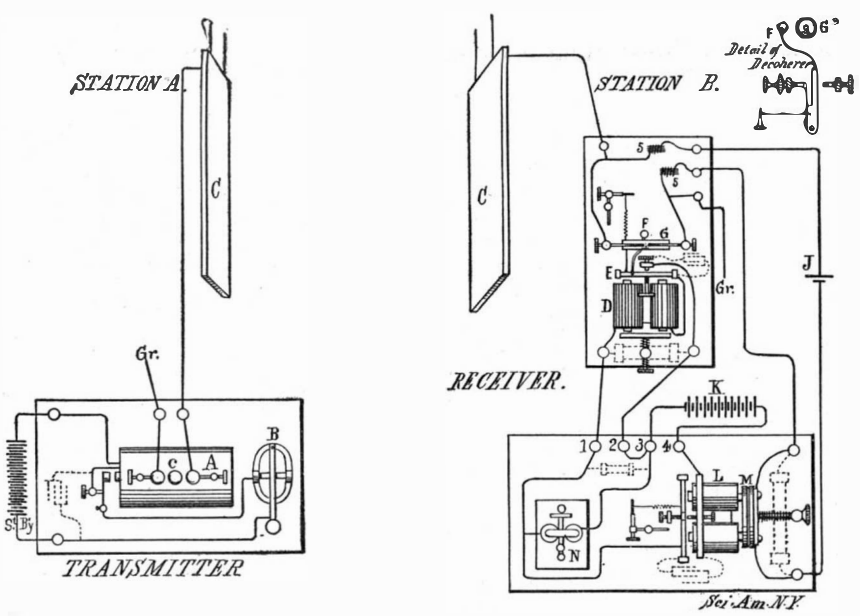


INSTRUMENTS FOR TRANSMITTING MORSE SIGNALS BY MEANS OF WIRELESS TELEGRAPHY.



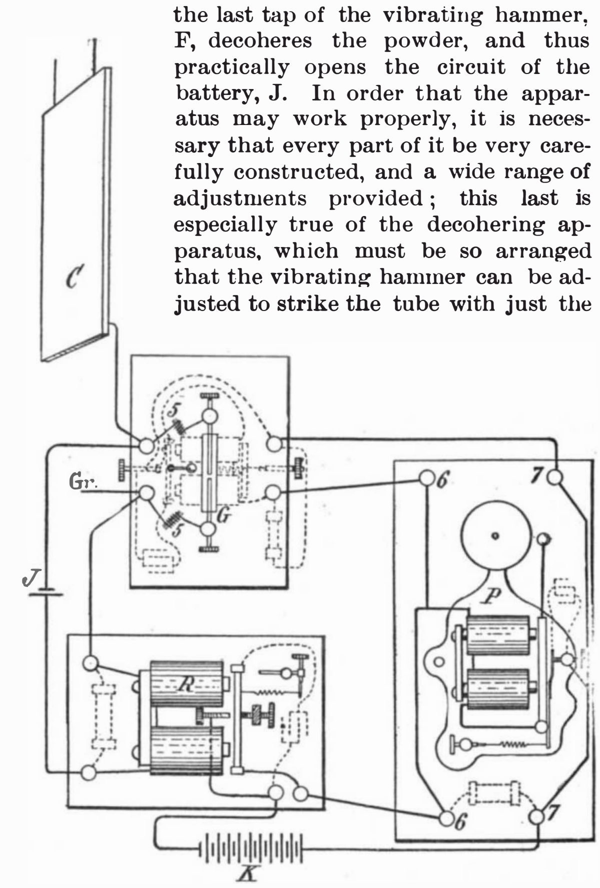
By reference to the diagrams it will be seen that both the transmitting and receiving stations are shown, station A being the transmitting and stations B and C the receiving. The transmitter shown at station A consists of an induction coil, A, specially constructed so as to give the most efficient kind of spark for the purpose. The coil is fitted with an ordinary vibrating make and break, constructed so as to give just the requisite number of interruptions. A special Morse key, B, is placed in the primary circuit, and the condenser is so connected as to kill the spark at the key contact as well as at the vibrating contact. Mounted on the upper part of the coil are three solid brass balls, C, the center one being stationary, and the outside ones adjustable, so that their distance from the center ball can be regulated at will. The two outside balls are connected to the terminals of the secondary coil, as are also the binding posts shown at the side of the coil. It will now be readily seen that when the key, B, is depressed, sparks will pass between the balls and will immediately cease when the key is released. By means of the two binding posts at the side of the coil, one terminal of the secondary coil is connected to earth, and the other terminal to the large metallic plate, C, which should be placed high in the air. The coil may be operated by any suitable battery, but a small storage battery is very much to be preferred.

The receiver at station B consists of two separate instruments, the Clarke coherer relay being mounted on one base, and the polarized receiving relay and sounder upon another. The coherer, G, is a small glass tube made of selected glass, and carefully fitted with two metallic plugs, whose distance from each other in the tube can be readily and accurately adjusted by means of the screw and spring adjustments shown at each end of the tube. The space in the tube between the plugs is partly filled with specially prepared metallic powder, and the two plugs are connected to the binding posts shown, through the small choking coils, 5. These posts are connected to the magnets, L, of the receiving relay through the main battery, J, and binding posts of polarized receiving relay as shown.

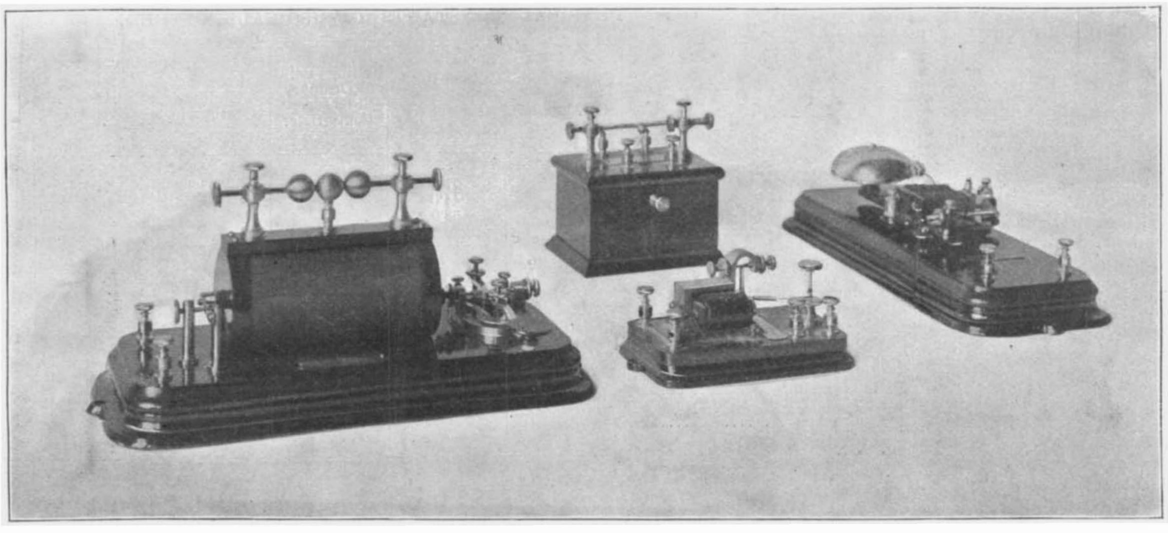


WIRELESS TELEGRAPHY—INSTRUMENTS AND CIRCUITS.

One terminal plug of the coherer, G, is connected to earth as shown, and the other terminal plug is connected to the large metallic plate, C, which like the plate at the transmitting station should be placed high in the air. When the powder between the plugs in the tube is lying in its normal condition its resistance is extremely high, often reaching 20,000 ohms, but when the key of the transmitter at the distant station is depressed, electric waves are sent out into space; these waves travel from the plate, C, of the transmitter to the plate, C, of the receiver, and finally reach the powder in the tube, G. Under the action of the waves, the particles of powder in the tube immediately cohere, and their resistance instantly drops down to between 7 and 25 ohms, which great decrease in resistance permits the current from the battery, J, to pass through the circuit, and energize the magnets, L, of the polarized receiving relay, which in turn operates the sounder, N, using the large local battery, K. When the powder in the tube once coheres, it remains in that state until the tube receives a sharp tap, when the powder instantly decoheres and its resistance rises again to an extremely high point. In order that Morse signals can be transmitted it is necessary, of course, that the tap on the tube be automatically accomplished. In order to secure this the decohering magnets, D, are provided and placed in multiple with the magnets of the sounder, so that the sounder and decohering apparatus will operate simultaneously; the decohering magnet operates the vibrating hammer as shown, which it will be seen will keep constantly tapping the tube as long as the key at the distant station is depressed, the powder refusing to decohere as long as the waves are passing through it; but the moment that the key at the transmitting station is released, the last tap of the vibrating hammer, F, decoheres the powder, and thus practically opens the circuit of the battery, J. In order that the apparatus may work properly, it is necessary that every part of it be very carefully constructed, and a wide range of adjustments provided; this last is especially true of the decohering apparatus, which must be so arranged that the vibrating hammer can be adjusted to strike the tube with just the necessary strength of blow. It is also found necessary to have all the magnets wound to a very high resistance, and their terminals provided with resistance coils of still higher resistance; and as the sparks produced by the contacts of the polarized receiving relay, and also by the vibrating contacts of the decohering apparatus, send out waves which affect the coherer, these sparks must be almost entirely suppressed by the use of suitable condensers in the bases of the instruments. This set of apparatus is used for the transmission of Morse signals to moderate distances only, but for longer distances it is simply necessary to use a much larger and properly designed induction coil in connection with the transmitter.



WIRELESS TELEGRAPHY—APPARATUS FOR BELL SIGNALS.



INSTRUMENTS FOR TRANSMITTING ELECTRIC SIGNALS BY MEANS OF WIRELESS TELEGRAPHY.

It is frequently desirable to dispense entirely with Morse signals, and

this is especially true on shipboard or in places where there is much noise and where a much louder signal or a visual signal is required. To meet these requirements a much less expensive set of apparatus has been designed. The transmitter is precisely the same as in the preceding case, but the polarized receiving relay, R, is much smaller and is not provided with as sensitive adjustments, it having been found that for bell signals they are not necessary. The sounder is entirely dispensed with, and is replaced by a high class vibrating bell, shown at P in the diagram of receiving station C. This bell is so arranged that it can be adjusted to work in unison with the vibrations of the decohering apparatus. The Clarke coherer relay in this case is mounted on top of a mahogany box which contains the decohering magnets, resistance coils for bridging the terminals and also condenser for suppressing the spark at the vibrating contact, as fully shown in the diagram at station C. The plugs in the cohering tube, G, are provided with the same adjustment as in the more elaborate set. The working of the apparatus is perfect in every respect. When required, the vibrating bell, P, can be replaced by an incandescent lamp which can be readily turned on and off from the distant station. It is certainly extremely interesting to place the transmitter of this set in one room and the receiver in another and then listen to the vibrating bell ring out loudly in response to every impulse of the waves. No ground connection, however, or air plate is required for either set of apparatus when the distance between the transmitter and the receiver is comparatively short. For the benefit of those who wish to experiment, and perhaps endeavor to build their own apparatus, a simple coherer is provided which is shown in perspective in one of our half tone illustrations and in detail in the lower engraving. The outer binding posts of this coherer are intended to hold two light rods of metal of equal length projecting out on either side. These rods or wings are necessary when it is desired to transmit to any considerable distance without using the earth connection or air plate.

LIQUID AIR AND ITS PHENOMENA.

PROF. W. C. PECKHAM, ADELPHI COLLEGE.

Renewed interest has recently been awakened in the liquefaction of air by the announcement that it can be produced in practically unlimited quantities. This result has been brought about by the development of the method of expansion, and its use in a new and ingeniously devised apparatus. Credit for this is due to Mr. C. E. Tripler, of New York, who has for many years been engaged in the study of this problem.

Our first page illustration shows the appearance and arrangement of his plant. It consists of a triple air compresser, a cooler and a liquefier. The compresser is of the ordinary form, having three pumps upon one piston shaft working in a line. The first gives 60 pounds pressure; the second raises this to 750 pounds, while the third brings the air under a compression of 2,000 pounds per square inch.

After each compression the air flows through jacketed pipes, where it is cooled by city water. For this work about 40 horse power is employed. After the third compression the air flows through an apparatus which disposes of some of its impurities, and it passes on to the liquefier. It is this part of the apparatus which constitutes Mr. Tripler's special invention. By means of the peculiarly constructed valve, whose details are not made public, a portion of the compressed air is allowed to expand into a tube surrounding the tube through which the remaining air is flowing. This expanded air absorbs a large amount of heat from the air still under compression in the inner tube. The contents of the inner tube are thus cooled. In this way the air is brought below the temperature of liquefaction and its pressure is very much reduced, so that, upon opening the valve at the bottom of the apparatus, a stream of liquid air is received, flowing out with scarcely more force than the water from our ordinary city service pipes. Thus the liquefaction of the air is accomplished by the "self-intensification of cold" produced by the expansion of a portion of the compressed and cooled air, without employing any other substance to bring about this result.

In this lies the difference between the process employed by Wroblewski and Olzewski many years ago, in the liquefaction of various gases, and finally, in the liquefaction of air by Olzewski and Dewar.

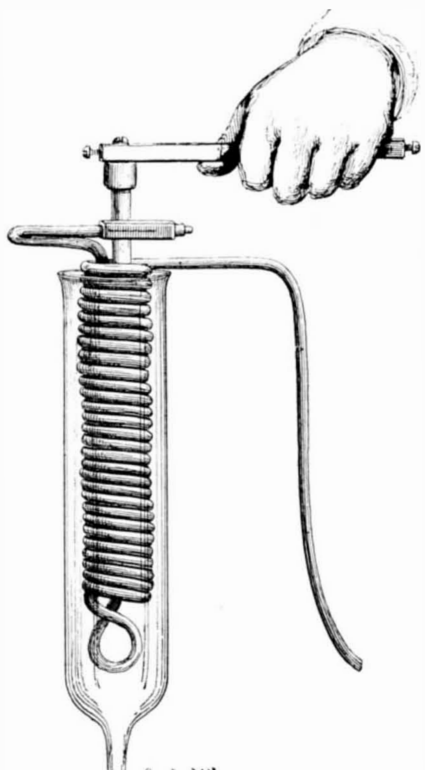
Through the courtesy of Mr. Tripler, we are able to present a cut of the original apparatus by means of which, in January, 1890, the first liquid air was made in America, and probably in the world, by this means. It is known that the method by expansion of air under pressure has been employed both in England and Germany, but the earliest published date connected with any of these experiments is 1895, and previous to that time, as Mr. Tripler states, his application for an English patent was on file in the English Patent Office.

Our cut of this original apparatus shows the tube through which the air under compression flowed into the spiral coil. Having traversed this coil, it rose through a tube (not seen) in the middle of the coil and passed the valve shown at the top. The whole was surrounded by a glass tube open at the bottom. By the expansion of the escaping air the coil and the inner tube were so cooled that liquid air trickled down the pipes and dropped out at the bottom of the tube.

This most interesting piece of historical apparatus is only 12 inches long and 1$\frac{3}{16}$ inches in diameter. Its capacity was of course extremely small as compared with the great plant which will deliver from 30 to 40 gallons of liquid air per day of 10 hours, with an expenditure of from 40 to 50 horse power, and its operation must have been extremely slow, as compared with the operation of the modern plant, which will give liquid air in less than 15 minutes after the pump is started.

As fast as the liquid air is drawn from the liquefier it is placed in tin cans, packed in felt, in which it can be kept for a very long time. Cans have been sent as far as Lynn, Mass., in one direction, and Washington, D. C., in the other, and the contents were not seriously diminished by evaporation in transit. Such a can holding 3 gallons would not wholly evaporate in less than 8 to 10 hours.

Prof. Dewar invented a double walled glass bulb, in which between the walls a high vacuum is formed (see Fig. 8). In this the air will last five to six times as long as in an ordinary packed dish. Indeed, it lies practically quiet without boiling, while in an open dish (see Fig. 9) the boiling is quite violent, and very soon the walls are covered with ice frozen from the moisture of the air. This is doubtless the coldest free liquid that has ever been produced. Its boiling point at the ordinary pressure of the atmosphere is —191° C.



TRIPLER'S ORIGINAL APPARATUS—USED IN 1890.

An extended table of the physical constants of the "so-called" permanent gases is embodied in this article and will doubtless interest our readers. A glance at this will show that the boiling point of the air is the lowest temperature thus far attained at atmospheric pressure. Only hydrogen and helium having lower boiling points, and neither of these has been liquefied up to this time in a free state, that is, at atmospheric pressure. The same statement can be made with regard to air boiling in a vacuum. This has the lowest temperature yet attained.

The possession of a large quantity of a liquid at so low a temperature makes it possible to perform many experiments of a very startling and marvelous character. When a dishful of the liquid air is dipped from the can, it boils so violently that drops of it are projected to quite a distance. This continues until the dish is cooled to the temperature of the liquid, when it becomes quiet, simmering gently. In this condition it is turbid, containing solid particles of carbonic acid and possibly ice. These may be filtered out through filter paper, and the liquid is seen to be of a delicate shade of blue, clear as water.

Since the boiling point of nitrogen is 13° C. below that of oxygen, it follows that, in the first boiling, nitrogen is distilled from the oxygen as alcohol may be distilled from a mixture of alcohol and water through the difference between their boiling points. By this means the liquid air becomes very much richer in oxygen. The liquid air would at first contain only 20 per cent of oxygen, but after boiling for a while the proportion of oxygen increases to 75 per cent. If the liquid be poured upon a block of ice, it bounds off like water from a hot stove. The ice at the freezing point is 344° F. hotter than the liquid air—a distance of 132° greater than separates boiling water from ice. We cannot comprehend it any better than we can comprehend the space which separates us from the sun. Although so cold, the hand may be dipped into the liquid or the liquid may be poured into the hand without producing much sensation, since the heat of the hand evaporates the liquid so quickly that a layer of vapor is formed around the hand; in other words, the liquid is thrown into a spheroidal state with reference to the hand. If, however, contact does take place between the skin and the liquid air, a most serious burn results. One day, when Pictet had a burn upon his hand from fire, he also produced one accidentally by liquid air; the ordinary burn healed in ten or twelve days, but the other was open for six months.

Fig. 4 shows a copper tube 2 inches in diameter, with walls one-eighth of an inch thick. On pouring a couple of fluid ounces of liquid air into the tube, and driving a wooden plug firmly in with a hammer, it is driven out almost immediately, and with such violence that boards overhead are indented by it. About 100 cubic feet of air are compressed into one gallon of the liquid, occupying 231 cubic inches. The liquid therefore occupies but $\frac{1}{748}$ of the space filled by the gas at first, and on returning to its gaseous form at atmospheric pressure, it must expand to 748 times its volume. The enormous pressure produced in this transformation is thus apparent. It would scarcely seem to be possible to construct apparatus in which it could safely be stored and allowed to come to atmospheric temperatures.

Fig. 3 shows the effect produced upon iron by reducing its temperature to that of liquid air. An ordinary tin dipper placed in the liquid and allowed to cool till boiling ceases becomes brittle and breaks like glass upon being struck against a table or thrown upon the floor. Copper and platinum, on the other hand, remain tough at the lowest temperatures. The tensile strength of iron would be increased very greatly by cooling.

Fig. 7 shows a dish of liquid air in which a rubber ball is floating. It will be noticed that the vapor flows over the edge of the dish, not rising in a cloud from it, as does steam, since it is much heavier than gaseous air at ordinary pressures. This vapor presents the appearance of a cloud of steam and would be easily mistaken for it. The chill which the hand receives on being exposed to it would, however, quickly convince one of the difference. When the rubber ball has been cooled to the temperature of the liquid, it becomes exceedingly brittle, and on being thrown against a wall flies into many pieces. A very curious effect produced upon a billiard ball or other article of ivory by cooling it to the temperature of liquid air has not been explained. On exposing it to the arc light for a few seconds and viewing it immediately in a darkened room, it shines with a brilliant green phosphorescence. It is possible that many other substances, such as eggs and bone, may be found to possess the same property. Whisky and alcohol are frozen with little difficulty by means of this liquid. It is a curious experiment (see Fig. 12) to hold

PHYSICAL CONSTANTS OF (SO-CALLED) PERMANENT GASES.

	Critical Temperature. Centigrade.	Critical Pressure. Atmospheres.	Boiling Point at Ordinary Pressure. Centigrade.	Freezing Point. Centigrade.	Freezing Pressure. Mm.	Density of Gas.	Density of Liquid at Boiling Point.	Color of Liquid.
Carbon dioxide, CO_2	31° [1]	77·0	—78·2° [3]	—79° [2]	760 [2]	22	0·83 @ 0° [4]	Colorless.
Ethylene, C_2H_4	95·0	44·0 58·0	—110 [5]			14		
Hydrogen, H_2	—234·5 [6] (Theor.)	20·0	—243·5 [6] (Theor.)			1		Colorless.
Nitrogen, N_2	—146	35·0	—194·4	203 —214 Mean 208	60	14	0·885	Colorless.
Carbonic oxide, CO	—139·5	35·5	—190·0	—207·0	100	14		Colorless.
Argon, A	—121·0	50 6	—187·0	—189·6		19·9	About 1·5	Colorless.
Air	—140·0	39·0	—191·0	—207 [9]			0 933	Bluish.
Oxygen, O_2	—118·8	50·8	—182·7			16	1·124	Bluish.
Nitric oxide, NO	—93·5	71·2	—153·6	—167·0	138	15		Colorless.
Marsh gas, CH_4	—81·8	54·9	—164·0	—185·8	80	8	0 415	Colorless.
Helium, He			Below —264 [7] (Theor.)			2·02 [8]		
Fluorine			—187					

[1] Andrews. Deschanel Nat. Phil., II., 352.
[2] Villard & Jarry. Comptes Rendus, 1895, 120, 1413.
[3] Regnault. Muspratt's Chemie, IV., 1626.
[4] Thilorier. Muspratt's Chemie, IV., 1626.
[5] Fownes. Elem. Chem., 12th ed., p. 534.
[6] Olzewski. Phil. Mag., 1895 (5), 40; 202.
[7] Olzewski. Ann. Phys. Chem., 1896 (2), 59, 184.
[8] Clève. Compt. Rend., 1895, 120, 1212.
Dewar.

a tube in which is liquid air in a glass of whisky, which in a few minutes becomes frozen solid. On warming the outside of the glass the solid whisky may be removed, and we have a whisky tumbler composed of whisky itself, but the whisky is in a condition suitable only for consumption in the Klondike.

A jet of carbonic acid directed into a dish floating in a glass of liquid air (see Fig. 13) is immediately frozen and forms carbonic acid snow, in the open air, which, on being placed upon a table, passes into the gaseous state without melting. A jet of steam directed into a glass of the liquid air causes a violent evaporation of the air and condensation of the steam, so that a cloud of particles rolls away from the dish, but in a remarkably short time round hailstones of the size of peas will be found floating quietly in the liquid air. They have cooled from +212° to —312° Fah. in the short space of a few seconds. Consider how much heat they have given up. The heat of evaporation of water is 967° Fah.; 212° more to zero; 144° given off in freezing and 312° more in falling to the temperature of liquid air; 1,636° is the grand total. Eighty degrees per second would be a moderate estimate of the rate of loss. More remarkable still is it to see the air of a room condense upon the sides of a tube in which liquid air is boiling in a vacuum. Fig. 15 shows this experiment. When the pressure gage registers about half an atmosphere, the liquid air is seen to be boiling in the tube with violence. Ice crystals from the moisture of the outside air coat the exterior of the tube; but trickling down through these crystals, and falling off to the floor, are the drops of the atmosphere of the room condensed directly at ordinary pressure into the liquid form. They disappear almost instantaneously in a cloud of vapor upon the floor, not wetting it at all—a most singular sight to see a liquid which does not wet the surface upon which it strikes.

A most striking experiment has been designed by Mr. Tripler, as were many of the experiments which have been already described, to show the tensile strength of frozen mercury. Fig. 10 illustrates this. Into a paper dish is poured a quantity of mercury. Into the ends of the dish have been inserted a pair of heavy screw eyes. If this dish is placed in a basin of liquid air, the mercury is quickly converted into a solid, since its freezing point is relatively high; 30° below zero. Now this, suspended in the manner shown, will support a heavy weight for a long time. A block an inch square in cross section will not melt under 20 to 30 minutes. Of course, anything else could be done with the frozen mercury which might be done with any other similar piece of metal; as, for example, it might be used to drive a nail.

Possibly the most striking experiment is this: A quantity of liquid air is poured into a tea kettle, and the kettle is set over a hot fire of coals; the liquid air evaporates and shoots in streams from the spout of the kettle in a straight column to the height of 3 to 4 feet—a sight which Watt never dreamed of. While this is going on, if a glass of water is poured into the kettle, it will be found to be frozen in a very short time; and if the kettle is removed from the fire, its under surface is found to be covered with the carbon dioxide of the fire frozen solid within a couple of inches of the red hot coals.

All the experiments usually performed in illustrating combustion in oxygen may be performed with heightened effect by means of liquid oxygen, separated from the nitrogen in the manner already described. A piece of sponge, saturated with the liquid oxygen, when touched by a taper from a safe distance, explodes with violence and is blown into fine shreds (see Fig. 6).

A most beautiful experiment is shown in Fig. 5, in which a newspaper crumpled into a roll has been saturated with liquid air, and is set on fire at one end. It burns with violence, but not so rapidly as in the liquid oxygen.

An electric light carbon may be heated to a red heat at its tip, and then plunged vertically into a deep glass of liquid oxygen, as in Fig. 14. A most singular combustion takes place. The heat of the carbon evaporates the oxygen in its immediate vicinity, and the carbon burns with great brilliancy and violence, forming carbon dioxide, which is largely frozen in the liquid air before it reaches the surface and falls back to the bottom of the dish, so that the combustion is maintained and its products retained within the dish.

Of course matches will be relighted, a piece of paper take fire or a cigarette burn if a spark remains in any of these, upon exposing them to the oxygen in the glass of liquid oxygen. Fig. 2 shows the mode of igniting a steel pen or watch spring in the liquid oxygen. It is only necessary to stick the point of the steel into a match and light it, to furnish a sufficient heat to communicate the fire to the steel, when it burns with the same brilliancy as in the ordinary experiment.

Fig. 11 shows a very brilliant experiment. A large flask, 10 or 12 inches in diameter, is filled to the neck with water. Into the top of the flask liquid air is poured. This at first floats, since the specific gravity of liquid nitrogen is 0·885; but as the nitrogen boils away, leaving the oxygen behind, the drops of oxygen begin to sink into the water, since its specific gravity is 1·124. As these drops sink, they are partially turned into vapor, which of course tends to rise through the water. This action communicates a rapid whirling motion to the oxygen, and drives it back again. This may be many times repeated, giving a very beautiful exhibition, since the drops of oxygen may be as large as an inch in diameter.

The magnetic character of liquid oxygen can be exhibited on a large scale in the manner shown in Fig. 1. A test tube with a side tube is filled with liquid oxygen, and a cork inserted. The side tube allows free evaporation to take place. This is then suspended, as shown, by a sling. If an electromagnet be brought near the end of the tube, the tube swings toward and adheres to the pole of the magnet just as if it were a piece of iron. This is, perhaps, the first adaptation of this experiment for exhibition on a large scale.

The enormous force of liquid oxygen is illustrated in Figs. 16 and 17—an experiment which was tried at the request of the inventor of one of our best known guns. A heavy steel tube 18 inches long and of about an inch bore, open at both ends, was securely fastened in a vise. Into the middle of the tube a plug of cotton saturated with liquid oxygen was placed. This was touched off by a taper from a safe distance. The effect of the explosion is shown in Fig. 17, which is a careful drawing from the tube itself.

The practical uses and applications of liquid air have not yet been made, but doubtless the inventive world will find a place and a use for this new power. Already inquiries in this direction are somewhat numerous. The scientific aspects of the matter are of the highest interest. By boiling liquid air in a vacuum, the lowest degree hitherto attained has been reached, and men are brought the nearest they have ever been to the absolute zero. It would appear that, at the point reached, chemical action has well nigh ceased. Even that most active element fluorine, whose chemical affinities at ordinary temperatures are uncontrollable, becomes comparatively inert. It has recently been cooled in oxygen boiling in a vacuum to —210° C. without solidifying. It became a liquid at —187° C. In its liquid form it had apparently no desire to attack anything excepting only substances containing hydrogen, such as turpentine and benzine. Its well known action upon glass entirely ceased. It would seem probable that men have reached in liquid air boiling in a vacuum a temperature quite comparable with that of the spaces between the stars, and that we may realize in a faint degree something of the time when stars and sun have ceased to shine and grown cold.

The Current Supplement.

The current SUPPLEMENT, No. 1161, contains many articles which will interest our readers. As promised in our issue of last week, the present number contains the full biographical notice of the late Sir Henry Bessemer, taking up in detail his various discoveries and inventions. "Tests of Bicycle Wheels" forms the subject of an article on a new departure in the testing of bicycles. The continuation of Judge Greeley's "Report of the Commissioner of Patents for 1897" is specially important, as it takes up the development of industries through patented inventions, including electrical railway, the telephone, the bicycle industry, the typewriter, amateur photography, cash registers, cash carriers, basic steel, aluminum, and other industries. "The Annealing of Copper" is a timely and practical article. The "Photographic Investigation of 150,000 Volt Power Discharge" is illustrated with engravings made from photographs taken during a disruptive discharge at a very high voltage. "The Solution of the Flight Problem" is an interesting study in aviation, treating of the scientific flight of birds. Among the articles of popular interest are "Bernard Palissy and his Art," "Perrault's Colonnade of the Louvre," "German New Guinea," "The Egg of the Dung Beetle," and "The Manufacture of Compressed Oxygen" on a Commercial Scale.

The Warships of the United States Navy.

Two full page illustrations, showing the comparative dimensions of the vessels of the United States Navy, with descriptive text giving full particulars as to size and armament, will be found in the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1046. Mailed on receipt of 10 cents by the publishers, or it may be ordered through booksellers and newsdealers.

PYROGRAPHY ON VELVET AND PLUSH.—The design must be bold in its outlines, and the pile inside of the pattern is singed off with the platinum needle. Care should be taken not to hold the needle vertically, so as not to burn the ground of the material. It should be held more horizontally, but not too much, else the points of the bordering fibers will be scorched. A little practice is necessary before starting at a larger work. When the above is done, brush off the hairs and lay in the colors as desired in the ground thus deepened. Bronze or gold may also be employed for this purpose, and looks still better.—Die Mappe.

Science Notes.

Prof. Alexander Graham Bell has been elected president of the National Geographic Society, Washington.

London's big fire has led the County Council to authorize an increase in expenditures of nearly a million dollars right away, and to add $125,000 a year to the estimates.

The Physikalische Verein, of Frankfort on the Main, proposes to erect a memorial to the late Philipp Reis, the inventor of the telephone. The society, of which Dr. Petersen is the president, has appointed a committee to further the scheme, the carrying out of which is estimated to cost about $7,500.

Prof. David P. Todd, Director of Amherst College Observatory, Amherst, Mass., U. S. A., has nearly completed a bibliography of eclipse research to join on with Ranyard's classic work published many years ago in the Memoirs of the Royal Astronomical Society. He would be glad to receive copies of papers and titles of works and articles published since 1875.

Father Kneipp left 850,000 marks for the continuance of the various Kneipp institutions at Wörishofen.

Dr. Thomas Egleston, emeritus professor of mineralogy and metallurgy at Columbia University, has presented the government of France with the sum of $5,000, in aid of the mineralogical collection of the School of Mines at Paris, from which he graduated in 1860.

Russia is beginning to honor her Siberian explorers. A statue is to be erected at Chabarowsk, on the Amur, of Deshnew, the Cossack who went by sea, in 1648, from the river Kolyma to the river Anadyr, thus sailing through Bering Strait for the first time, and proving that Asia was separated from America. It is proposed, moreover, to change the name of the East Cape into Cape Deshnew, which will probably be objected to by geographers.

Snow statues are the latest fad among artists; invented by Pierre Roche, a French sculptor of good reputation. The statue is made of copper, and in its lowest part a vessel with liquid carbonic acid is placed, whose slow evaporation generates great cold. On the metallic surface a snow or hoar frost-like covering is produced in a short time from the moisture of the air, which is prevented from thawing by the freezing solution in the interior.

The coldest inhabited country appears to be the province of Werchojansk, in Oriental Siberia, says The National Druggist. The mean altitude of the terrain is about 107 meters (about 390 feet) above the sea. A Russian savant passed one entire year in this inhospitable region and kept a daily record of the temperature, which he has recently published, and from which it appears that the daily mean of the entire year is 19·3° C., or 2·74° F., below zero! The daily mean for January, 1896, was 53° C., or 63·4° F., below zero.

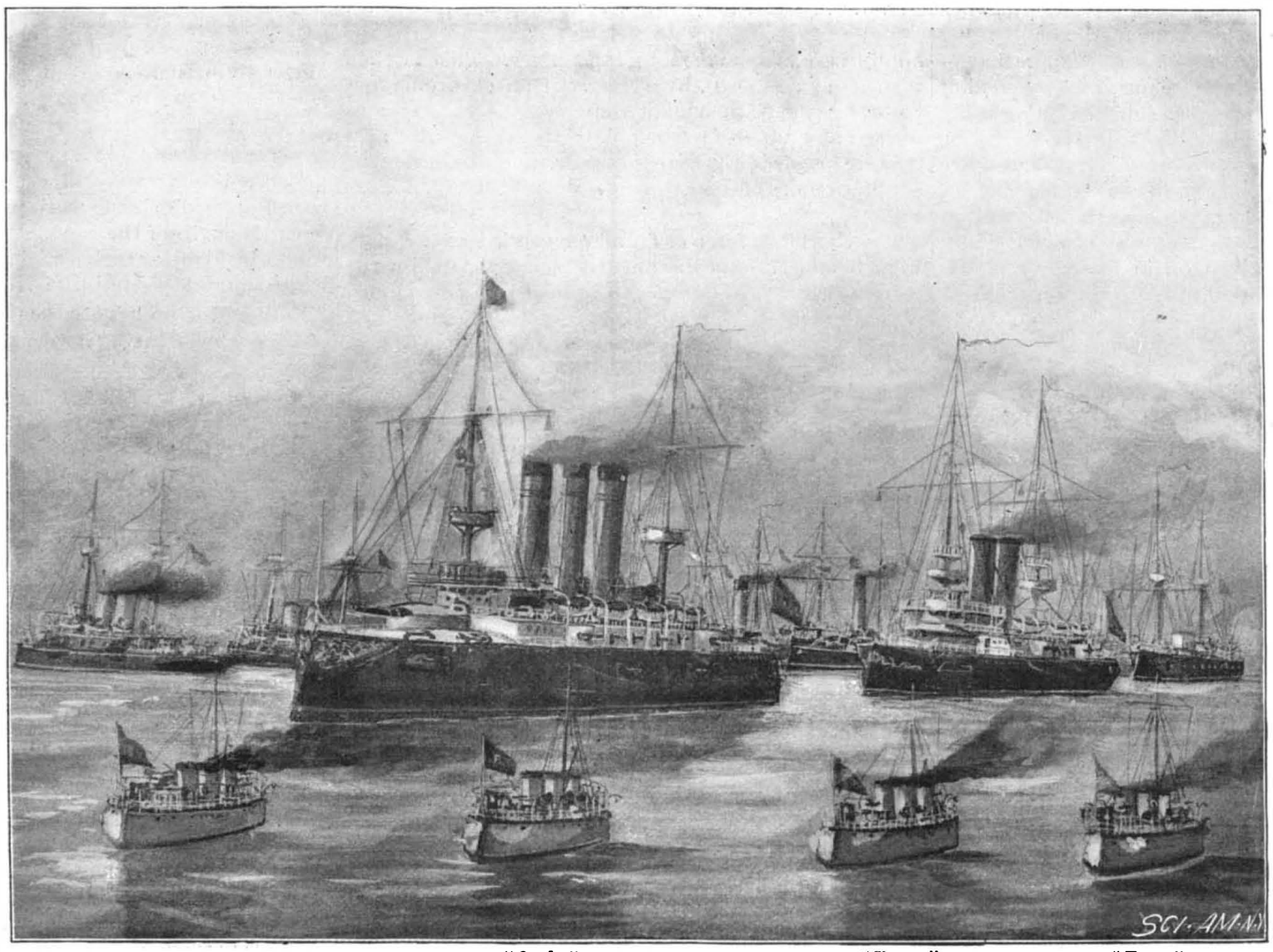
Dr. Colajanni, an Italian sociologist, living in Naples, has just completed a little monograph descriptive of the quarters in European cities having the largest number of inhabitants to the 1,000 square meters. In London the average to every 1,000 square meters is 196, in Paris it is 265, in Rome 280. In Naples there are 939, and in the Pendino quarter of that city 1,254. Dr. Colajanni makes an appeal to his government to remedy the terrible conditions of life in his native city. Living pellmell in buildings that cannot be called human habitations, lacking air, light and proper food, these Neapolitans show a harvest of death that exceeds from a quarter to a third the average mortality of the rest of Italy. Dr. Colajanni adds: "The ancient legend, 'Vide Napoli e poi morire,' is a sad truth today. For, in the magic horizons and under the azure heavens are the most active laboratories of death existing on the face of the globe."

According to Dr. Bell, in The Scottish Geographical Magazine, the forest fires of Canada are generally caused by lightning. In the great forest between Alaska and the Straits of Belleisle the portions recently burned are easily recognized by the tenderer green of their foliage from the parts which have been longer spared. The fire rushes along with the speed of a galloping horse. The branches and dead leaves on the ground burn like tinder and the flames rise to nearly 200 feet. Resinous pinewoods burn fastest. One of them extended 160 miles in ten hours. The traces of a fire remain for nearly a century. Birds and beasts are stifled or burned. Beavers and muskrats, which are amphibious, have a chance of saving their lives. After the fire a few trunks of the largest trees are left. Next spring roots begin to sprout and seeds to grow. In fifteen or twenty years the soil is covered with poplars, willows, etc., which shelter young firs and other trees. In fifty years the conifers are uppermost, and in one hundred the others are dying out beneath the pinewood. A third of the forest region of Alaska has trees of fifty years old, another third trees of fifty to one hundred years, and the rest trees over one hundred years old. The fire seems to suit the Banksian pine, as it opens the pines and sets free the grains. Without fires this species would hardly reproduce itself. Such fires took place even in the Pleistocene epoch of geology.

THE NAVIES OF THE UNITED STATES AND SPAIN—A COMPARISON.

While we are hopeful that the existing difficulties with Spain may even yet prove to be capable of adjustment by peaceful methods, it is likely that if hostilities come at all they will come quickly. It is equally certain that the issues of war would be determined upon the sea, and a brief comparison of the fighting strength of the two navies will be just now of special interest.

"Maria Teresa." "Alfonso XII." "Carlos V." "Isla de Luzon." "Ensenada." "Cisneros." "Numancia."



"Audaz." "Osado." "Terror." "Furor."

THE FIGHTING LINE OF THE SPANISH NAVY.

Could we defeat Spain upon the high seas? It is safe to say that there is not a citizen of this country that doubts for a moment that we could. To the lay mind the task of annihilating the Spanish navy appears not only certain, but easy; to the professional mind, as represented by the men who design and fight our ships, the task appears equally certain, but by no means so easy of accomplishment.

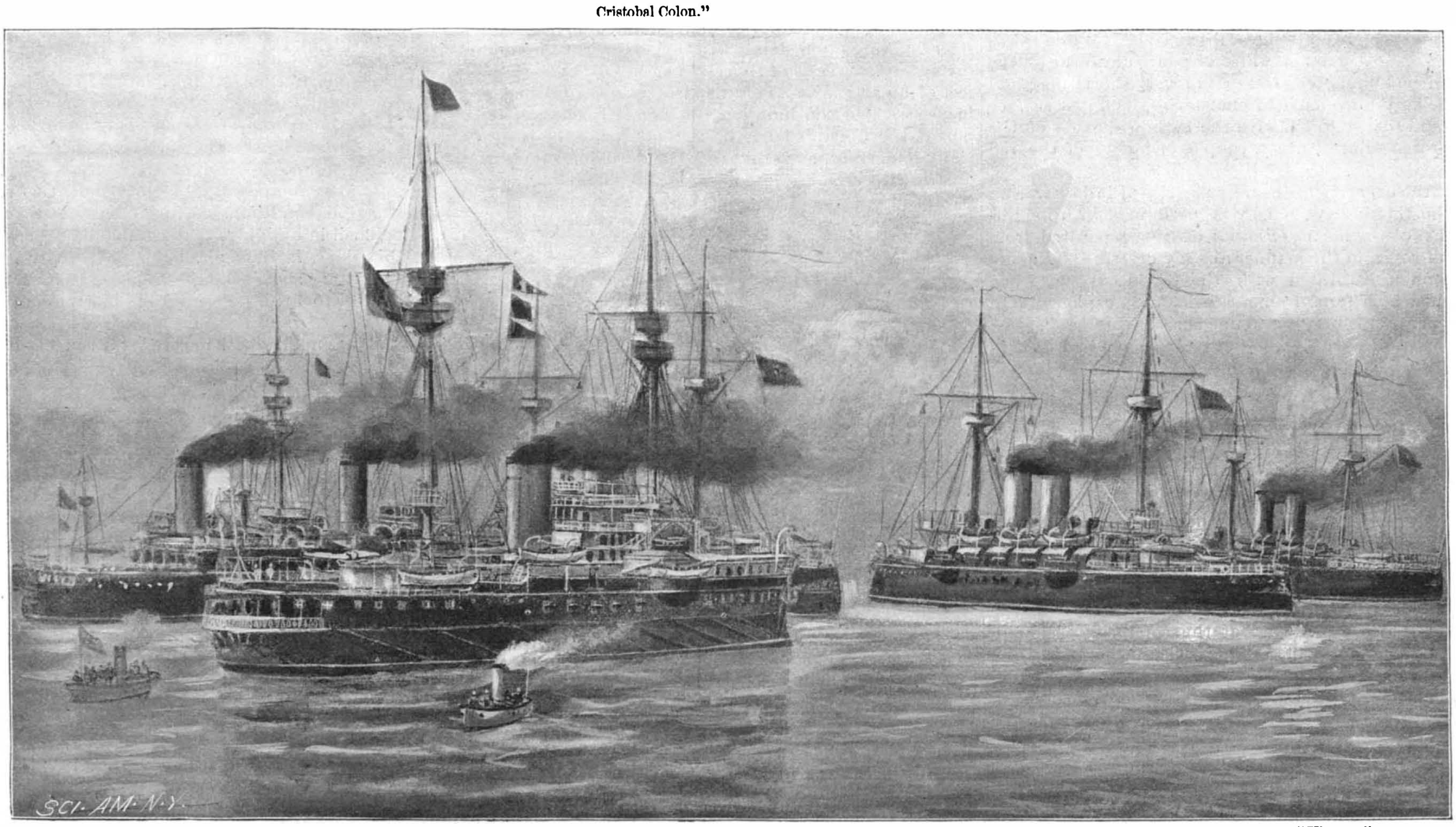
It is better to over rather than underestimate an opponent, and it is best of all to rate him at his true value; hence we may as well admit at the outset that Spain would go into the war, as far as her ships are concerned, with a homogeneous, compact and very formidable fleet—one which, if properly handled and bravely fought, would be a by no means unworthy opponent for the powerful ships of the United States navy. Each fleet would be strong where the other is weak, and taking the two fleets as they stand—swift, heavily armored cruisers and deadly destroyers against mighty battleships and more lightly armored cruisers—the issue, judged independently of "the men behind the guns," would be by no means so certain as is popularly supposed. The man behind the gun, however, would be the controlling factor, and it is the supreme confidence of the American public in the pluck and discipline of the crews and the skill and daring of our naval officers which renders it so confident of final victory.

If war should come, it would be the object of Spain to obtain a decisive naval victory at the very outset. Cuba being the objective point of both combatants, the war would probably be carried on in Cuban waters. The almost insuperable difficulties of coal supply would prevent any delay in risky attempts upon our now well defended sea ports. The same difficulty would render it to Spain's advantage to wage an aggressive warfare and deal as early as possible an effective blow in a general engagement. The approach of the powerful battleship "Oregon," from the Pacific, would prompt such a policy. It is more than likely that a numerous squadron, comprising all the powerful armored fighting ships of the Spanish navy and their recently completed torpedo-boat destroyers, would be dispatched to give battle to our combined fleets in the neighborhood of Cuba.

We will suppose that only the armored ships would be placed in the first line of battle, and for the purpose of comparison, we will suppose that all the modern armored ships of Spain would be sent over in the effort to win a decisive battle.

The Spanish line could boast of only one first-class battleship, the "Pelayo." She is a 9,900-ton ship, of 16 knots speed, carrying two 12½ and two 11-inch guns in 11-inch steel barbettes, placed high above the water line. She has a 17·7-inch steel belt along the whole water line, and her secondary battery contains nine 5½-inch rapid-fire guns. She is a good ship, but possesses the fatal defect of having no armor protection between the barbettes and the belt. On this account, high explosive shells bursting beneath the barbettes might easily put them out of action. To the "Pelayo" we could oppose the "Iowa," of 11,410 tons, carrying four 12-inch guns, eight 8-inch guns, and a secondary battery of four 6-inch guns. She is protected by a 14-inch belt, and the main battery is protected from the turret roof down to the belt with 15 inches of steel. She is thus larger and more heavily armed and armored than the "Pelayo," and, saving the chances of a modern sea fight, should easily silence or sink the Spaniard.

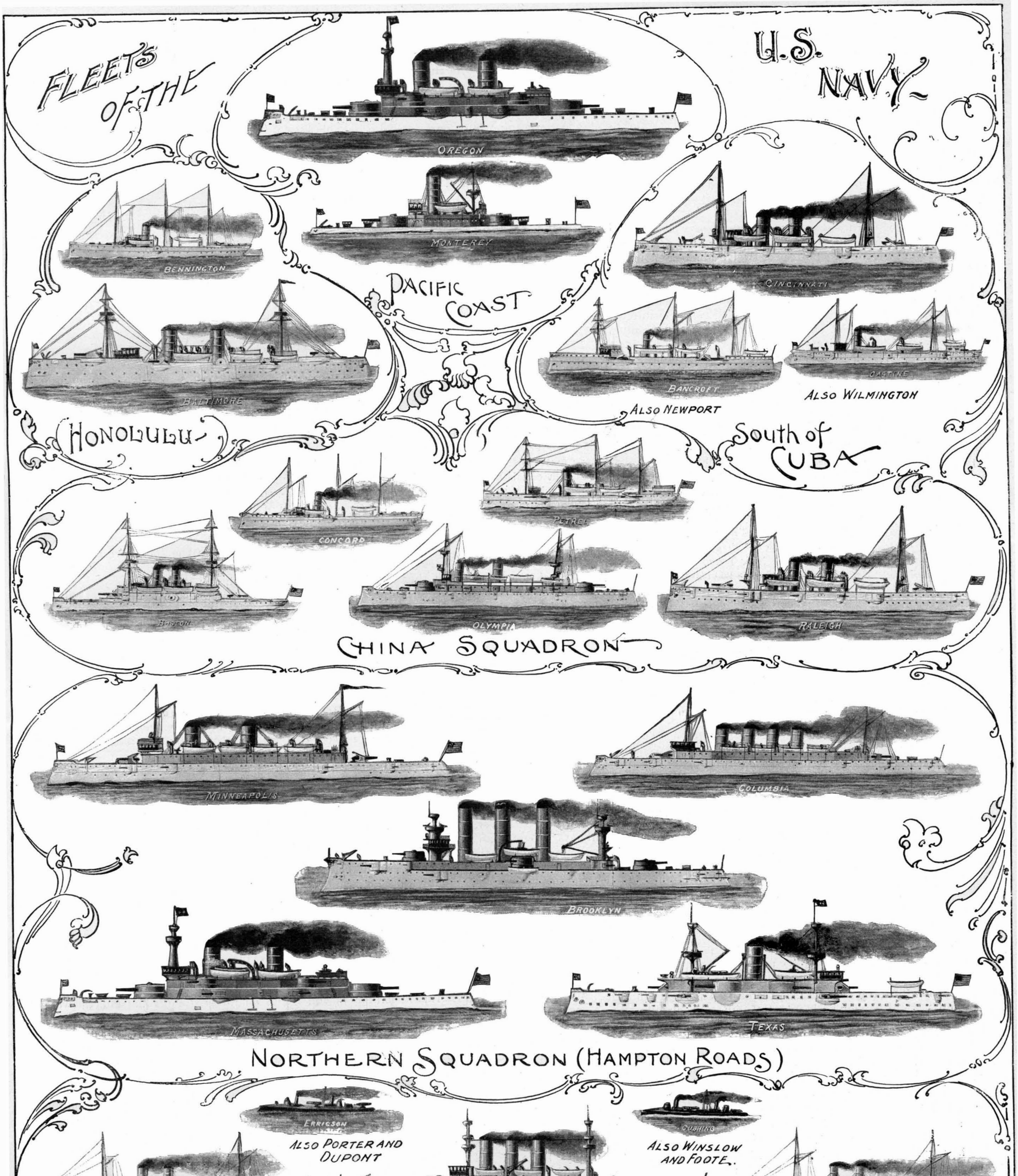
Cristobal Colon."



"Vitoria." "Pelayo." "Oquendo." "Vizcaya."

THE FIGHTING LINE OF THE SPANISH NAVY.

With the exception of its one first-class battleship, the Spanish line of battle would consist of a magnificent fleet of eight swift, heavily armed and heavily armored cruisers, similar in size, speed and power, and admirably adapted to act together in a concerted fleet


FLEETS OF THE
U.S. NAVY
OREGON
MONTEREY
BENNINGTON
CINCINNATI
BALTIMORE
PACIFIC COAST
BANCROFT
CASTINE
ALSO WILMINGTON
ALSO NEWPORT
HONOLULU
SOUTH OF CUBA
CONCORD
PETREL
BOSTON
OLYMPIA
RALEIGH
CHINA SQUADRON
MINNEAPOLIS
COLUMBIA
BROOKLYN
MASSACHUSETTS
TEXAS
NORTHERN SQUADRON (HAMPTON ROADS)
ERICSSON
ALSO PORTER AND DUPONT
CUSHING
ALSO WINSLOW AND FOOTE.
MONTGOMERY
NEW YORK
MARBLEHEAD
DETROIT
ALSO NASHVILLE
IOWA
INDIANA
TERROR
SOUTHERN SQUADRON (KEY WEST)
PURITAN

action. There is no nation in the world that possesses such a fleet, not even England, and the fact that the ships are all built to carry the large normal coal supply of 1,200 tons would seem to indicate that they were built for just such an emergency as now confronts them.

The most important and largest of these ships is the "Carlos V.," of 9,235 tons and 20 knots speed. Her curved deck plating is 6½ inches thick, and her secondary battery is protected by a continuous belt of 2 inches of steel. She carries two 11-inch guns disposed in two barbettes of 10-inch steel, and a secondary battery of eight 5½-inch and four 3·9-inch rapid-fire guns. Against her we could oppose the "Brooklyn," which closely resembles her in many points. She is of 9,250 tons displacement, 21·9 knots speed and is protected by a steel deck 6 inches thick on the slopes, to which is added a belt of 3-inch steel extending in the wake of the engine rooms and boilers. She carries an exceptionally heavy battery of eight 8-inch guns, protected by 5½ and 8 inches of steel, and a secondary battery of twelve 5-inch rapid-fire guns. Unless a lucky shell from the great 11-inch guns of the "Carlos V." should find its way into her engine or boiler room, she should prove more than a match for the Spaniard.

Following the "Carlos V." in importance is the "Cristobal Colon," built in Italy, whose sister ship, the "Varese," the Spaniards were very anxious to purchase from Italy. This is a most interesting ship, and it is a question whether, in spite of her smaller size—6,840 tons—she is not more formidable than the "Carlos V." The remarkable feature in this ship is the extensive armor protection, which is so complete as to entitle her to be called a battleship rather than a cruiser. A 6-inch steel belt encircles the whole waterline. Above this is a redoubt of continuous 6-inch steel which completely protects a battery of ten 6-inch rapid-fire guns, and above this is another battery of six 4·7-inch rapid-firing guns. The main battery consists of two 10-inch armor-piercing guns in 6-inch barbettes. The speed is the same as that of the other cruisers—20 knots. Against this boat we could oppose the "New York," a smaller edition of the "Brooklyn." She is of 8,200 tons displacement, 21 knots speed, and is protected by a 4-inch belt and a curved deck 6 inches on the slopes. The armament consists of six 8-inch guns and twelve 4-inch rapid-fire guns, the gun positions being protected with casements and turrets of from 7 to 10 inches of steel. The superior protection and heavier secondary battery of the "Cristobal Colon" should render her a fair match for the "New York."

Following these two ships in importance is a group of six sister ships, two of which are already very familiar to the people of New York. They are the "Almirante Oquendo," the "Cardinal Cisneros," the "Cataluna," the "Princesa de Asturias," the "Infanta Maria Teresa" and the "Vizcaya." The "Maria Teresa" represented Spain at the Grant Memorial services last year and lay for some time off Riverside Drive in the Hudson River, and the "Vizcaya" visited this port immediately after the Maine disaster.

Each of these six ships is of 7,000 tons displacement and 20 knots speed. They are provided with a belt of 12-inch steel, at the top of which is a 3 inch protective deck. At each end of this belt an armored tube rises to connect with a barbette of 10½-inch steel, and in each barbette is an 11-inch armor-piercing gun. Between these guns is a battery of 5·5-inch quick-firing guns.

Against these speedy ships we could oppose two powerful first-class battleships, the "Indiana" and "Massachusetts," the armored cruiser "Texas" and four powerful monitors, the "Puritan," "Terror," "Amphitrite" and "Miantonomoh." In point of guns and armor the advantage would be vastly in favor of the battleships and monitors, though this would be offset by the speed, handiness and ability to use the ram of the Spanish cruisers. In an artillery duel there could be little doubt of the issue. In heavy guns the seven American ships have eight 13-inch, ten 12-inch, twelve 10-inch and sixteen 8-inch, a total of 46 armor-piercing guns against a total of twelve 11-inch guns on the six Spanish ships. This superiority however would be greatly offset by the murderous discharge of the secondary rapid-fire batteries of the Spaniards, which would comprise sixty 5½-inch guns, against which we could only make reply with fourteen 6-inch and eight 4-inch guns. The result of such a duel would be that the unarmored ends and the central secondary batteries of the "Indiana," "Massachusetts" and "Texas" would be blown away, while the armor belts of the Spanish ships would be pierced and the ships either sunk or disabled.

Thus far, however, we have taken no note of two other novel and hitherto untried elements, which would at least figure prominently in such a battle, if they did not prove to be its deciding factor. We refer to the armored ram "Katahdin," of the American fleet, and the deadly torpedo boat destroyers of the enemy. The "Katahdin" is a vessel of 2,150 tons and 16 knots speed, whose sole duty is to ram. For this purpose she presents but little of her bulk above the water, and that which is visible is curved and armor-plated with a view to deflecting the shells of the enemy. She is quick in turning, and it would be an extremely difficult task for a warship to elude or sink her before the fatal blow was struck.

The six destroyers, "Audaz," "Osado," "Terror," "Furor," "Pluton" and "Proserpina," are the fastest and most formidable of their class. They have a speed of 30 knots and carry two discharge tubes for the deadly Whitehead torpedo. As they are unarmored, they can be easily sunk by gun fire, and for this reason they will rarely make an unsupported attack in the open. In line of battle, however, they will be certain to play a very important part. Sheltering themselves behind the advancing ships (which they can easily do, on account of their small size), they will rush out at the opportune moment and fire their torpedoes at the enemy. So greatly is the torpedo dreaded that the hostile fire is certain to be drawn away from the battleships and concentrated on the destroyers in the effort to sink them. This diversion will be of great value to the fleet possessing a torpedo flotilla, and may easily turn the tide of battle at a critical moment. The moral effect which these boats will produce in a naval battle is shown in the naval war game which we illustrated in the last issue of the SCIENTIFIC AMERICAN SUPPLEMENT. We have nothing of the size and speed of these 400-ton destroyers which we could send against them, unless it were the "Porter" and "Dupont," of 28 knots. Our torpedo boats would be too small to accompany a fleet on the high seas.

The possession of a numerous torpedo flotilla by Spain goes far to restore the balance which, on account of our battleships and monitors, would be strongly in our favor in a pitched battle, and it is the knowledge of this fact which renders the sailing of the flotilla for the West Indies a matter of the gravest concern to this country. The flotilla consists of six torpedo boat destroyers and six torpedo boats convoyed by a couple of small cruisers. The boats have been stripped of their guns and torpedoes and they are being nursed across the water by the larger boats, which are ready to give them all necessary assistance. The flotilla in its present condition is as helpless as a brood of ducklings, and it is no doubt the knowledge of this fact that has led Spain to hurry them across the water in time of peace.

It will be noticed that in the foregoing comparison we have taken no note of protected cruisers and gunboats, for the reason that these have theoretically no proper place in a battle between armorclads. Of protected cruisers Spain has two of 5,000 tons, three of 3,090 tons and three of 1,000 tons, besides some older wood and iron ships of less value. Against these we could at present oppose on the Atlantic two protected cruisers of 7,500 tons, one of 4,000 tons, one of 3,600 tons, one of 3,200 tons, three of 1,750 tons and sixteen of from 1,000 to 1,500 tons.

In torpedo gunboats and craft of under 1,000 tons displacement Spain is stronger. She has fourteen torpedo gunboats of from 500 to 850 tons displacement and 19 to 22½ knots speed, and over ninety small gunboats, many of which, however, are obsolete. We have three gunboats of less than 1,000 tons displacement, among which is included the "Vesuvius," with its pneumatic guns for the discharge of dynamite shells.

Should the war be prolonged, our navy would rapidly increase in strength. The "Oregon" would reach eastern waters, and in a few months we should have the powerful battleships "Kentucky" and "Kearsarge" in commission, to be followed later by that celebrated trio, the "Alabama," "Wisconsin" and "Illinois." Our torpedo fleet would grow apace, and it would not be long before we should have an overwhelming superiority upon the seas. We are indebted to La Ilustracion for our illustration of the Spanish fleet.

Government Alaska Literature.

We have received from the United States Geological Survey three excellent works regarding the gold fields of Alaska and the Yukon district. The first is intended for general distribution. It is entitled "A Map of Alaska, Showing Gold-Bearing Rocks, with Descriptive Text Containing Sketches of the Geography and Geology of the Gold Deposits and Routes to the Gold Field." The map is large (57 miles to the inch) and clearly colored, showing all the gold districts, and the various routes to all parts of Alaska are clearly indicated. This important pamphlet is written by S. F. Emmons, aided by W. H. Dall and F. C. Schrader. It will prove of great use to prospectors and miners who might visit Alaska. There are 40,000 copies printed. The other two books are not of as great interest to the prospector but are important to those who are interested in geology and to the mining expert. The "Geology of the Yukon District, Alaska," by Josiah Edward Spurr, with an introductory chapter on the history and condition of the district to 1897, by Harold Beach Goodrich, an abstract from the eighteenth annual report of the Survey. It is a quarto of 392 pages and is illustrated by 51 plates in addition to maps. The third book is "The Reconnaissance of the Gold Fields of Southern Alaska, with Some Notes on General Geology," by George F. Becker, which is also an abstract from the eighteenth annual report of the Survey. It is illustrated by maps and excellent half tone engravings. The books have been published most opportunely.

THE TOTAL SOLAR ECLIPSE, JANUARY 22, 1898.

There could hardly be a greater difference than between the eclipses of 1896 and 1898. The shadow track in the former case ran through a vast extent of country which offered, however, but few suitable sites. These were clustered together at two or three main points, and in almost every case the intending observers were disappointed of the spectacle which they had come to see. In 1898 the eclipse track lay chiefly in one single country which offered a large number of easily accessible sites, nearly all of which were occupied, and all were favored with the most perfect weather. Up to the present time it certainly is the record eclipse, either as regards the number of observers, the character of their equipment, or the uncheckered favor which they experienced from the weather.

"A victory all along the line" is what we have to record. The full significance of that victory, and what results may accrue from it, it will take us many months to learn.

As a sensation, the eclipse did not fulfill the popular descriptions. Whether, as has been asserted, the corona was unusually large and bright, or, from the special atmospheric conditions prevailing in India at the time, the darkness was much less than is usual in any eclipse of two minutes' duration, the general effects in color, light and the appearance of the landscape were very much those which were brought about more slowly some four and a half hours later, some thirty-five or forty minutes after the sun had set. At any rate, the light at mid-totality was certainly greater, considerably greater, than we ordinarily get at night at the full of the moon.

The fall of temperature was, however, considerable, amounting to some twelve degrees ; and it was noticed by some of those who had taken part in the Norway expedition of 1896 that, whereas on that occasion the darkness of the eclipse was felt to be a sensible relief from the unceasing sunlight, so now the coolness of the eclipse was a relief from the too powerful heat of the sun.

Consistently with the small amount of darkness of the eclipse, the approach of the shadow at the beginning of totality was less marked than usual, and in some places, though watched for, escaped notice. The only record that has yet reached me of its approach having been distinctly observed is from Dr. Robertson, of Nagpur. The shadow bands were also looked for at some stations without success, though they were caught at both Jeur and Nagpur. At the latter place Miss Henderson, M.D., describes them as having been faint dusky ripples some two inches in breadth, and separated from each other by about the same interval, and in appearance and speed of motion resembling the ripples seen on the ceiling of a cabin in an ocean steamer as they are deflected through the porthole from the water outside.

Of the stars visible during the eclipse, one caught every attention, and was, indeed, seen after totality had passed. This was the planet Venus, some six degrees southwest of the sun at the time. Mars, though very small and further from the sun, was also glimpsed and some two or three other stars were noted.

The shape of the corona recalled at once that of 1896, and with it the two earlier years, 1868 and 1886, which it had resembled. To the southwest a long ray nearly in the solar equator was easily traceable for two, if not three, solar diameters from the dark limb of the moon. On the east side a pair of broader and less extended streamers formed a single connected structure in which the characteristic coronal curves were repeatedly seen.

Bearing in mind that these four years all fell at the time of small but not of minimum sunspot activity, it appears clear that we have here brought out a third coronal type as distinct and definite, perhaps even more so than those which have been already recognized as appropriate to the times of actual maximum and minimum ; and it may be hoped that we have now material enough to enable us to trace the course of change which the corona undergoes in its passage from one extreme form to the other.

It may be opportune here to correct a widespread misapprehension, that minimum coronæ are small and faint except for the two great equatorial rays. The reverse would seem to be the case, except in the immediate neighborhood of the sun's pole. The corona, for instance, of 1878, so far from being small and faint, was unusually large and bright ; and the present one, though we have not yet reached the actual minimum, possesses the same characteristics.

The feathery structure round the solar poles, which was so plainly seen in the eclipse of 1878, and which has been recognized more or less clearly at so many eclipses since—especially at or near the time of minimum—was very apparent on the present occasion.

The photographs of the corona have been unusually numerous, and have been taken on every variety of scale, from a diameter of a single millimeter with a hand camera, up to one a hundred times as great. The latter were obtained at three stations : by the Astronomer Royal at Sahdol, with an aperture of nine inches and an enlarging lens; by Dr. Copeland, at Gogra, near

Nagpur; and by Prof. W. W. Campbell, at Jeur, with telescopes of about forty feet focal length. Next in order to these giant photographs come the standard instruments of the Joint Eclipse Committee, with their twin cameras giving images of an inch and a half and of six-tenths of an inch. These were employed by Prof. Turner at Sahdol and Captain Hills at Pulgaon. The cameras taking photographs of one inch in diameter and smaller were much too numerous to recount; but special note should be made of Prof. Burckhalter's device for obtaining both the inner and outer corona on the same plate by means of a revolving screen worked by a spindle passing through a hole in the center of the plate, which diminished the exposure given to the bright central regions of the corona so as to bring it more in accord with the faint light of the outer extensions.

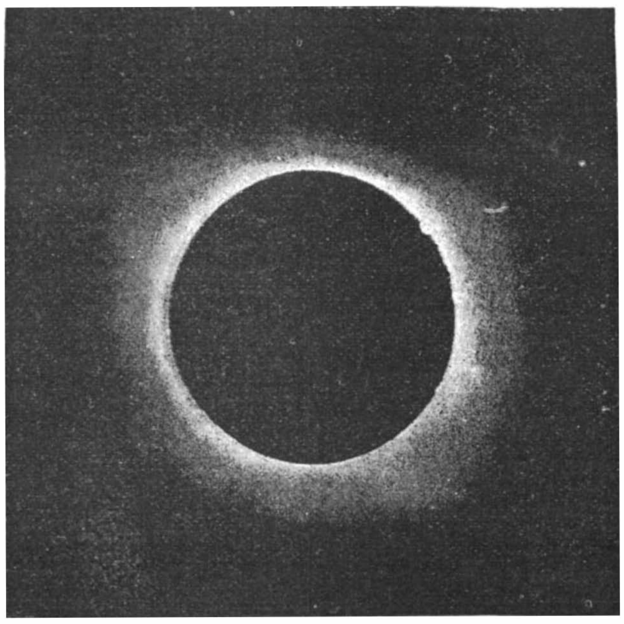
At the extreme ends of the line of stations a novel experiment in coronal photography was attempted. At Buxar, on the Ganges, and at Viziadrug, on the coast, a kinematograph was employed so as to obtain a continuous series of photographs of the progress of the eclipse. The former instrument was supplied by Mr. Nevil Maskelyne, and was worked by the Rev. J. M. Bacon, the astronomer in charge of one of the two parties organized by the British Astronomical Association, and the other was in the hands of Lord Graham.

Of direct visual spectroscopic observations there were few. Mr. Newall and myself endeavored to trace the distribution of coronium—that is, of the substance which shows its presence in the 1474 K line; but the line was faint, and it could only be ascertained that it showed a general conformity to the shape of the brighter part of the inner corona, without its being possible to ascertain whether it corresponded in minuteness of structural detail. No rifts were detected in it.

The photographs of the spectrum claim the highest interest, and these were of unprecedented number and value. Capt. Hills, at Pulgaon, with two great slit spectroscopes, obtained records of the "flash," both at commencement and end of totality, which give a complete history of the spectroscopic changes seen in the various strata of the sun, from its ordinary spectrum up to that of the prominences at Viziadrug on the coast. Mr. Fowler and Dr. Lockyer were equally successful with prismatic cameras of six inches and nine inches aperture, while smaller spectrographs of extreme beauty, and ranging from C in the red far into the ultra-violet, were secured by Mr. Evershed, at Talni.

The examination and interpretation of these photographs will be the work, not of days and weeks, but of months, and possibly years; but we may confidently look to them for a complete answer to many questions which are engaging the attention of solar physicists at the present time, and particularly for information as to the exact locale of the absorbing vapors which give rise to the Fraunhofer lines. Sir Norman Lockyer's theories, in particular of dissociation in solar and stellar atmospheres, will be put to the severest test, and our knowledge of solar mechanism can hardly fail to receive a great advance.

One inquiry which it was hoped the present eclipse would advance has failed to meet with success. Mr. Newall was endeavoring to ascertain if the spectrum of the corona, as obtained from the two opposite limbs of the sun, gave any evidence of relative motion in the line of sight due to rotation. It will be remembered that in 1893 M. Deslandres came to the conclusion that the corona rotated in essentially the same period as the photosphere. Mr. Newall had arranged an exceedingly beautiful instrument for this purpose—a spectroscope, the collimator view telescope of which was parallel to the polar axis. The spectroscope was also provided with a double slit, the one slit tangential to one limb and the second to the other limb; the one slit stretching from the sun's equator northward, the other from the opposite end of the equator southward. The experiment, which abundantly deserved to succeed, was, however, frustrated by the faintness of the coronal spectrum.


THE SUN'S CORONA, TOTAL ECLIPSE, JANUARY 22, 1898.

Of other observations it is scarcely possible to speak as yet. It should, however, be added that the polariscope, which has been almost forgotten in eclipse work for the last fourteen or fifteen years, was very successfully used, both at Sahdol and at Pulgaon, and the clearest indications were secured of strong radial polarization.

Such is a very brief outline of the principal results (so far as we yet know them) of this the most completely successful eclipse on record. The above article was contributed by E. Walter Maunder, F.R.A.S., to Knowledge.

The Correspondence Schools' Car.

A handsome car for the International Correspondence Schools of Scranton, Pa., has just been built at Wilmington, Del., and will shortly be sent on a tour through the manufacturing cities of the country. The length of the body of the car is fifty feet and the width is nine feet eight inches over the sills. The interior is divided into compartments as follows: A reception room eighteen feet long, furnished in quartered oak and fitted with bookcases, center table, wicker chairs, couch, etc. There are four sleeping sections of upper and lower berths, eight in all. The seats forming the lower berths are covered with plush and fitted with head rests. Tables are provided, to fit between the seats, for holding books, writing materials, etc. At the extreme end of the car there is a toilet salon. On the panels between the windows there are suitable inscriptions accompanying the names of the various inventors and scientists, such as John A. Roebling, George H. Corliss, George Westinghouse, Jr., Sir Henry Bessemer, Abram S. Hewitt, Thomas A. Edison, Michael Faraday, etc. It is proposed to locate the car for a time in the immediate vicinity of large manufacturing establishments, thus affording those interested a practical demonstration of the methods in which the work of the schools is carried on.

RECENTLY PATENTED INVENTIONS.

Engineering.

ROTARY ENGINE.—Frank A. Boyd, New Rochelle, N. Y. This invention provides an engine of comparatively simple construction which is designed to be of high efficiency and not liable to derangement of working parts in service. In a suitable casing, the driving shaft carries a bucket wheel, on the sides of which and near the periphery are track rings having V-grooves in their outer edges, while in an adjustable concave-faced bracket block supported from the casing, there being side plates on the block, are induction and exhaust passages having communication with the buckets of the wheel, there being adjustable gates in these passages.

Railway Appliances.

CAR DOOR FASTENER.—Reynolds H. Johnson, Long Island, Kansas To hold a sliding car door in place and prevent its rocking or jarring back, the fastener is, according to this invention, applied near the rear edge, pivoted bolts engaging the adjacent door jamb having bifurcated lever arms, a bar connecting the arms of the bolts, and the bar sliding in a mortised keeper. A drop key engages the keeper to hold the connecting bar at either end of its throw, and is provided with a lateral spur to prevent accidental displacement. All parts liable to be displaced and lost are dispensed with, and the arrangement is such that the seals cannot be tampered with nor the bolts disturbed without its being readily discovered from the outside of the car.

RAILROAD SWITCH AND FROG.—Charles E. Harris, Ellwood City, Pa. This invention provides a peculiar construction of the rails by which objects which lodge between the fixed and movable rails will be raised out of the groove by the operation of the switch. In the complementary rails for the switches and frogs, one rail has a horizontal recess opening to one side and extending beneath the tread portion and the other rail has a side projecting flange fitting and adapted to enter the recess, one of the rails having the opposed surface of that part above the flange beveled away from the other rail.

DUST GUARD AND AXLE WIPER.—James S. Patten, Baltimore, Md. The dust guard proper, according to this invention, is composed of two metallic members, preferably flexible cast brass, and helical springs arranged in inclosing keepers which are composed of integral semicircular portions formed on one member, and an integral face on the other member, the portions being opposite and adapted to slide on each other, the upper member having lateral lugs which form supports for the springs and slide with them into the keepers or pockets when the guard is adjusted to an axle. An integral lateral flange has angular wiping portions that are flush with the concave edge, while intermediate bridging portions serve as caps for the spaces between the wiping portions.

RAILWAY TRACK TIE AND FASTENING.—William A. Detwiler, Cincinnati, O. This invention relates to means for quickly locking rails to metallic ties, the fastening being easily removed, if desired. The tie may be of cast or sheet metal, with a concave body and pendent integral angular flanges having in their horizontal portion an opening with convergent or beveled sides, while rail clamps fitting loosely in the top openings have claws to engage the tie, wedges holding both the clamp and tie in locked position. A firm and cheap fastening is thus provided, which can be applied with great rapidity.

UNCOUPLING LEVER.—Robert H. Munger, Quimby, Ia. To facilitate lifting the coupling pins of car couplings of the Janney type, this invention provides a pin lifter comprising a two-part rock shaft supported to rock on the end of the car, one part of the shaft having a crank arm loosely shackled to the coupling pin, and the other part of the shaft being flattened at the outer end and provided with a handle lever, a coupling box loosely connecting the two sections of the rock shaft, and there being means for loosely connecting an arm on the cranked sections of the rock shaft with a pin-lifting device on the roof of the car. Means are provided for temporarily maintaining the vertically slidable coupling pin in elevated position, to be automatically dropped by the impact of two meeting cars.

Mechanical.

TURBINE WATER WHEEL.—Samuel and Arthur C. Martin, Muddy Creek Forks, Pa. The hub of this wheel is carried on a vertical shaft, and is curved inwardly from the top and bottom, the blades consisting of metallic plates running throughout the height of the wheel, and the lower portion of each blade having an extension which forms the bucket, the buckets being below the plate where the water is introduced to the wheel at the upper side of a horizontal platform, there standing on the plate a series of tangential partitions forming sluices through which the water passes. With the special form of blade employed, the water received on its upper curved portion is forced downward, so that water from one sluice cannot come in contact with the water from the next sluice and destroy its force.

Agricultural.

CHECK ROW FOR PLANTERS.—Firman S. Breckenridge, Caledonia, Mo. A simple and inexpensive attachment is provided by this invention, the markers being adjustable so that the rows may be checked with great accuracy at any desired distance apart. The attachment comprises a marking wheel having a hub made in sections capable of adjustment one upon the other, there being locking devices for the sections and arms projected from one of them, points being adjustable upon the arms. The device can be applied to any two-horse corn planter, and to those having revolving seed drops as well as those having reciprocating slides.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS, ETC.

LIBRARY OF THE WORLD'S BEST LITERATURE. Thirty volumes. Charles Dudley Warner, Editor, and Hamilton Wright Mabie, Lucia Gilbert Runkle, George H. Warner, Associate Editors. New York: R. S. Peale, J. A. Hill.

It is impossible in any single review to give an adequate idea of the marvelous scope of this work, and the high plane on which it has been brought out, from both a literary and artistic point of view. The work has been in progress of publication for the past two years, and the appearance of each successive volume has been a continual surprise, even to those who had formed the highest anticipations of its excellence. Its primary purpose has been the interpretation of literature in essays by scholars and writers competent to speak with the highest authority, such essays embodying critical, interpretative, biographical and historical comments upon authors and their works. From a long list of eminent contributors we note a few only of the great names which appear: Andrew D. White, ex-president of Cornell University; William Dean Howells, the distinguished novelist and critic; Ferdinand Brunetiere, the famous French critic; Prof. Lounsbury, of Yale University; Dr. Lyman Abbott, the successor of Henry Ward Beecher in Plymouth Church, Brooklyn; Prof. Charles Eliot Norton, of Harvard University; Dr. Richard Garnett, of the British Museum; Dr. R. H. Hutton, editor of The London Spectator; Dr. William T. Harris, chief of the National Bureau of Education, Washington, D. C.; Prof. John Bach McMaster, the great living historian; Dean Farrar, Dr. Henry Van Dyke, Julian Hawthorne, Col. T. W. Higginson, with others which might be added—enough to fill a column in the enumeration of authors alone.

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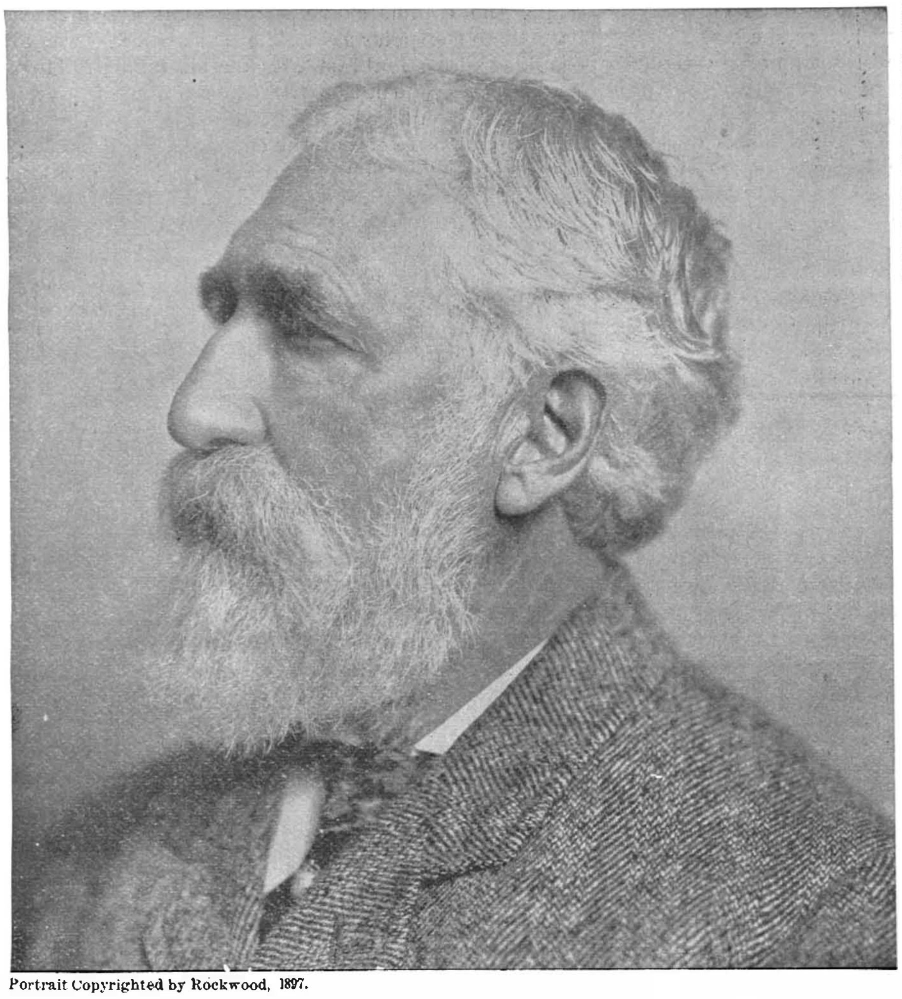
The work is made for both practical use and literary enjoyment, being a library to be read as well as a library of reference. It affords a general view of literature from remote antiquity to the present time, and contains the brightest and best reading from the brightest and best writers, speakers and thinkers of all ages, nations and periods. It treats of every important literary subject which the minds of men have considered for the past thirty centuries, and presents specimens of every class of literary quality—poetry, prose, history, biography, etc. As one of the most important characteristics of the century has been the spread of scientific knowledge, the literary work of Huxley, Tyndall, Pasteur and Agassiz receives full attention, especially in the departments of Astronomy, Geology, Geography, Navigation, Botany and Zoology, the great thinkers and philosophers, from Socrates, Plato and Aristotle to Galileo, Spinoza and Darwin, being represented by selections that are entertaining as well as instructive.

The last volume of this great work is now about to be issued, and it is reported that the sales thus far have reached the great total of 400,000 volumes.

WHAT IS LIFE? OR, WHERE ARE WE? WHAT ARE WE? WHENCE DID WE COME? AND WHITHER DO WE GO? By Frederick Hovenden. With cuts and diagrams. London: Chapman & Hall, Limited. 1897. Pp. 290.

This work is based on the author's previous book entitled "What is Heat?" Indeed, it is a sequel to that work. The author says that the practical purport of this book is the suppression and prevention of human suffering, so that institutions for the mitigation of human suffering may not be required to the present extent. The writer says that the facts in the text may be regarded as authoritative as well as up to date. The co-ordination and the deductions from the facts are the author's.

OBSERVATIONS UPON THE HERRING AND HERRING FISHERIES OF THE NORTHEAST COAST. WITH SPECIAL REFERENCE TO THE VICINITY OF PASSAMAQUODDY BAY. By H. F. Moore, Ph.D., Assistant United States Fish Commissioner. Washington: Extracted from United States Fish Commission Report for 1896. 1897. Appendix 9. Pp. 387 to 442.



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MARCH 22, 1898,

AND EACH BEARING THAT DATE.

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